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DIDAKTIK/FACHDIDAKTIK AS SCIENCE(-S) OF THE TEACHING PROFESSION?

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Preface

This publication arises from the work of Subnetwork E of the Thematic Network of Teacher Education in Europe (TNTEE) "Didaktik/Fachdidaktik as science (-s) of the teaching profession?" and also of the SOCRATES European Module "Didaktik". It is based upon collaboration that began at a TNTEE symposium at the European Conference on Educational Research (ECER) that was held in Frankfurt in September 1997. This meeting was followed by a seminar in Linz in March 1998 and by a further series of meetings of the group at the TNTEE Conference in Lisbon in May 1999. The first section of the book (chapters 1 to 9) focuses on Didaktik (General Didactics) and more general issues whilst in the second section (chapters 10 to 15) the discussion centres on Fachdidaktik (Subject Didactics) in particular subject areas such as mathematics, science, mother tongue, foreign languages and civics education. The final section (chapters 16 to 19) deals with interdisciplinary issues based on developments relating to Fachdidaktik in general.

Section I
General Didactics

The first chapter of this book is based upon the original "Invitation for discussion" by Helmut Seel that was presented at the first two meetings of the group. This framed the initial discussions and also subsequent developments and accordingly this chapter also frames the overall discussion in this publication as a result. In this chapter Seel discusses the relationship between "Allgemeine Didaktik" (General Didactics) and "Fachdidaktik" (Subject Didactics) and draws particular attention to the importance of the conception of "Bildung" in German pedagogy. It is recognised that the word Didaktik is not a commonly used term in the language of education in the English speaking world and that appropriate translations are not simple and straightforward but complex and problematic. With regard to Bildung this is seen to be central to the "anthropological basics and foundations" of educational sciences ("Erziehungswissenschatten") and, it is suggested, might best be translated as "erudition". Didaktik itself can be seen as the science whose subject is the planned (institutionalised and organised) support for learning to acquire Bildung. It is observed that human beings are born into a culture, a cultural environment, including a social system. Human personality is developing and shaping in a lifelong process. This development encompasses physical learning processes in interaction (maturation and decline) as well as psychical learning processes in interaction with other human beings and in dealing with cultural phenomena such as objects, institutions, ideas, sciences etc. The acquisition of, and the dealing with, cultural objects are seen as major aspects of Bildung as a process, which represents a cluster of learning processes. It is also noted that Bildung may be conceived as "an (intermediate) actual state in the process of personality development" and also that it can be seen as "an ideal norm". The learning processes are seen to lead to an integration of knowledge and rational thinking as "a basis for the competence to judge", volition "as a prerequisite for the readiness and ability to decide" and of competence which is

broadly conceived as "capability to act in an efficient and responsible way in social terms". Seel argues that "those processes of learning, which in their entirety represent the process of Bildung, receive their impetus by dealing with people and experiences with objects". The promotion of learning processes relevant to the acquisition of "Bildung" is seen to relate to two components, which are firstly "the selection of cultural components as goals and content of learning" and secondly "support for learning processes as regards their efficacy and success". The overall aim can be defined as "Gebildite/r" or "educated personality" which (i) comprises a sense of egalitarianism; (ii) relates to "central problems of living"; (iii) is concerned with "key problems" in society and (iv) relates to all human capabilities.

The second chapter by Pertti Kansanen also offers much to frame subsequent discussions in this publication. This chapter presents an historical overview of the development of the "Deutsche Didaktik" and compares it with the American tradition of research on teaching. Essentially this chapter presents a personal account of an enquiry in relation to the question "What is Didaktik?" This tradition is traced back to Johan Amos Comenius in the 16th century "as a practical and normative doctrine" and various trends within the 20th century are identified. These include "die Reformpädagogik" (Petersen *et al.*), "geisteswissenschaftliche Didaktik" (Klafki *et al.*), empirical-analytic Didaktik (Schulz *et al.*) and critical-communicative Didaktik (Habermas). The tradition of Didaktik is seen to be characterised by philosophical thinking, theorising and the construction of theoretical models. It is noted that Didaktik is a term that is used in Central Europe and Scandinavian countries and that it much less well known in English and French speaking countries. In emphasising the normative aspects of Didaktik, Kansanen suggests the translation as "the art of teaching". However an essential aspect to his analysis is the second order term which is described as "a model or methodology of how to envisage the teaching-learning process". The meaning of the term "curriculum" is also considered and it is noted how this is strongly culture bound and fraught with a variety of difficulties when being compared across linguistic boundaries. The absence of almost any discussion of Didaktik in British and American literature is highlighted. In relation to this phenomenon, a particularly significant section focuses on how the traditions (Deutsche Didaktik/ Anglo-American curriculum theory) separated in response to political and ideological circumstances. It is noted that reform pedagogy and "new conceptualisations of Didaktik" arose from critiques of the "mechanical application of Herbartianism" in the early part of the 20th century but that these developments did not reach American education, leading to "amazing disparities". Kansanen observes that a key characteristic of the different traditions was how the model for teaching in the United States came to be based on a business model. Under such a model teachers are perceived as a "labour force" which is to be motivated and managed through narrowly conceived systems of control and accountability. It is further noted how such an atmosphere was not encouraging to independent and autonomous action. In addressing the aspect of Fachdidaktik, Kansanen argues that only erudition-centred Didaktik/Geisteswissenschaften "has a clear position on this question". In essence the main task in this tradition is seen as a theory of educational content (Theorie der Bildungshalte) according to its value in the curriculum and in the instructional process. Finally some observations are offered on the "Nordic alternative" and the conflict between the different traditions of educational psychology/empirical research and geisteswissenschaftliche Didaktik/hermeneutics is highlighted.

In chapter 3, Brian Hudson begins by addressing the relationship between educational psychology and didactics and the role of didactics in teacher education. In relation to Didaktik, the role of Fachdidaktik is explored with specific reference to mathematics education from a UK (England) perspective. The emphasis on the social and cultural aspects of education that is apparent in Didaktik mirrors current debates in mathematics education that are discussed. Close parallels are seen to exist between Didaktik and Vygotskian cultural psychology and the related fields of activity theory and social practice theory. Two related issues that are raised by this discussion are firstly, the tension

between individualistic and social perspectives and secondly that between fragmentation and integration. The sources of these tensions can be traced back to differing perspectives on teaching-learning e.g. specialised training in specific skills (in the behaviourist tradition) in contrast with teaching-learning that is intended to "activate large areas of consciousness" (higher mental functions in the Vygotskian tradition). In considering developments in England and Wales over recent years, this is seen as a time of increasing fragmentation in terms of the curriculum in both schools and also more recently in teacher education. The style and approach of the Chief Inspector is seen to be an obstacle to constructive engagement with and the future development of the teaching profession and the, at times, adversarial approach of the Teacher Training Agency is seen to have been problematic. A further problem at the time of first writing this chapter was seen to be the lack of a "clear and explicit rationale" for the curriculum that was in sharp contrast with the concept of Bildung that is central to Didaktik. It was encouraging to see this problem being addressed recently, through a proposed statement of values and aims. However this is now seen quite widely as a rather timid response on some aspects such as multicultural issues. With regard to pedagogy, the relatively recent debate in the UK is welcomed although the atheoretical nature of this contribution to the debate from the Teacher Training Agency is noted and an alternative broader conception is proposed. The tradition of Didaktik is seen to offer real potential for informing future development in educational policy. In particular this tradition is seen as one which would enable a shift in thinking from a false dichotomy between teaching and learning and also a shift in emphasis in thinking about the educational process as being concerned with the development of "higher mental functions" rather than narrowly conceived technical competences.

Birgit Pepin explores existing models of knowledge in teaching in three different environments: the Anglo/American; the French; and the German scene in chapter 4. Particular attention is given to models of mathematics teaching. In each scene it is attempted to develop an understanding of the different aspects of the models, to comprehend their underlying concepts, how they are constructed, and in some cases how they developed historically. By doing this, similarities and differences could be identified. It is concluded, firstly, that what is common to all models in all countries considered is that knowledge in teaching is not seen as static, but as a process of development and change and that experience in the classroom contributes to its growth and change. Secondly, there are differences in terms of origins of concepts related to their background in terms of educational traditions. Thus, it is argued that models of knowledge in teaching have to be understood in terms of the countries' educational and cultural traditions in which they developed. It is proposed that this might usefully guide researchers to the development of a common understanding of what is generally called 'the science of teaching' or 'didactics', as well as to the identification of research and development projects in the areas of teachers' knowledge. In order to make the task manageable distinctive models were chosen for the Anglo/American scene, in particular that of Shulman in terms of teachers' knowledge in general, and that of Ernest in terms of mathematics teaching. For the French scene particular concepts were selected that originate in the French research on didactics and mathematics didactics, and these were linked with corresponding didactical theories. For the German scene the research drew almost exclusively on literature that presented and compared the German concept of *Didaktik* with the Anglo/American concept of research into teaching and curriculum. Therefore, the reader is asked to imagine a grid with three lines (Anglo/American; French; and German) and two rows (general didactics; mathematics didactics) which need to be filled with theories and concepts. The main emphasis of the paper is on the Anglo/American aspect, simply because in England the main literature is available in English and it is on the Anglo/American representation of teacher knowledge. It is argued that there is too little literature available in English on French and German theories, in order to appreciate the full volume of concepts and ideas of didactics in the French speaking or the German educational environment.

Friedrich Buchberger and Irina Buchberger consider the key aspects of professionality in chapter 5. As one among a number of key aspects they identify the existence of "(a) corresponding, well developed science(-s) and of (scientifically) validated practices for a particular (academic) profession". They highlight the fact that the teaching profession has not fulfilled these essential criteria in general within Europe, although they do point towards the fact that "much (scientific) knowledge and some (scientifically) validated practices relevant for teaching and learning in schools and the teaching profession have been developed". They argue that much of this knowledge has been produced by Erziehungswissenschaften ("educational sciences") and its subdisciplines (e.g. Didaktik, educational psychology) as well as by various Fachdidaktiken ("subject-related didactics") for different subjects. The concept of science (Wissenschaft) is used in the ("rather liberal") sense attached to it in continental European cultural contexts and is not seen to be restricted to natural sciences. They define Didaktik/fachdidaktik (DF) as (a) science (-s) of teaching and learning (both the (double) notion Didaktik/Fachdidaktik and the singular/plural with science (-s) reflect uncertainties). Accordingly DF is conceived as a transformation science dealing integratively with:

(i) contexts of teaching, studying and learning
(ii) aims and objectives of teaching, studying and learning
(iii) contents of teaching, studying and learning
(iv) teaching and learning strategies
(v) media and teaching/studying/learning aids
(vi) evaluation of teaching, studying and learning
(vii) actions of actors involved in the teaching/studying/learning process

As a science DF aims at the production of descriptive knowledge/theories (Beschreibungswissen), explanatory knowledge/theories (Erklaerungswissen), and efficiency-oriented knowledge/ technological theories (knowledge and measures to provide opportunities for change) (Veraenderungswissen). The latter is seen as a highly under-developed aspect in relation to education (teaching-studying-learning). This chapter aims to map out some of the main elements of the problem space, whilst not claiming to provide answers or solutions. These elements are categorised around six statements, which are as follows:

(1) Teaching and initial teacher education have to be oriented on the "state of the art".
(2) The "state of practice" of initial teacher education may be characterised as rather problematic.
(3) (Research-based) knowledge bases for teaching and initial teacher education do exist, but are used to a limited extent only.
(4) More research on teaching and initial teacher education is indispensable to increase the scientific bases on teaching and initial teacher education both in quantity and quality.
(5) DF conceived as an integrative transformation science might have the potential to become the main science of/for the teaching profession.
(6) Producing and adopting scientific knowledge bases to improve teaching/learning and initial teacher education calls for co-operative problem-solving processes of all actors involved.

In relation to (1), it is noted that educational sciences (including educational psychology and educational sociology) and especially a science of teaching has been difficult to establish in many initial teacher education curricula. The ambivalent nature of the relationship between the development process of educational sciences and teacher education in Germany is noted. Attention is also drawn towards the claim of Reynolds of the non-existence of educational sciences in England, whilst at the same time noting that he offers "a rather narrowly conceived conception of it focusing on research on effectiveness of teaching and learning". With regard to (2), attention is drawn to particular explanations of curricular problems in teacher education with reference to the notion of a "social

arena" of teacher education where different interest groups and lobbies try to keep their influence in a social "power game" (e.g. scientific/academic disciplines). The result of this power game may be that adaptations and re-orientations that are necessary because of changes in the context are not made. On the topic of statement (5) a preliminary model of DF as an integrative transformative science dealing with teaching-studying-learning is presented. Drawing on the work of Klafki, the notion of Allgemeinbildung (basic competence) is seen as of central importance. This model is seen as offering the possibility of opening up widely neglected areas of research into teaching and learning and also of contributing to the constructive empowerment of the teaching profession. In addition it is seen as offering the potential to reduce the dependency on external and political control including that from non-teaching related academic disciplines.

In his outline of Didaktik as the professional science of teachers in chapter 6, Helmut Seel highlights the tension between the pedagogical and didactical tradition of "geisteswissenschaftliche Pädagogik" (and the associated notion of "relative pedagogical autonomy for school and teachers") in German speaking countries with the more narrowly focussed Anglo-American concept of teaching theory. He also draws attention to Shulman's critique of a lesson-related instructional theory as being too limited for a scientific basis for professional practice. Further he highlights Shulman's critique of an exclusively psychological orientation on associated research. He also notes how a "renaissance of Didaktik" has taken place in German-speaking countries in recent years and proposes the need for such scientific theory and reflective practice in general. In outlining the professional science of teaching he identifies three components as firstly a theory of teaching, secondly a theory of Bildung and thirdly a theory of school. In his final section he considers the relation between Didaktik and subject-related studies which is seen as problematic and in need of clarification. A key issue is the unstable nature of subjects within the school system. For example some subjects were initially seen as knowledge and attitudes to deal with certain phenomena and problem areas of life, e.g. Erdkunde, Naturkunde, Wirtschaftkunde etc, whereas others were seen as skills such as languages, arithmetic and crafts. Also some subject disciplines are not represented at all in the elementary and lower secondary school systems such as medicine, law, astronomy and economics. A further key issues centres on the problems created by the organisation of the school into isolated subject-matter compartments. Such organisation is seen to run counter to the need for the integration of subject matters when faced with real life problems of a societal or personal nature. One way of overcoming these problems is seen to be through cross-curricular project-based approaches. Finally Seel points to the need for a continuous evaluation of the dynamic relationship between general didactics and subject-matter didactics.

In chapter 7, Gunn Imsen emphasises the distinction between the normative and descriptive aspects of Didaktik and addresses the notion of reflection as a "bridging concept" in this context. The normative aspect is seen as seeking principles and procedures to decide about aims, subject matter and teaching-learning methods in education, mostly for the purpose of educational planning. The descriptive aspect of didactics is seen to focus upon the teaching-learning reality, its contexts and the students' learning experiences, in order to understand the educational process. Traditionally and philosophically, these two aspects are seen to be clearly separate, though in educational practice, these two parts of didactics are seen to be intertwined. This chapter presents a comprehensive, analytical model, mapping the main components that make up the life in classrooms. This model is offered to serve as a tool in order to understand and to some extent explain the relationships between factors influencing classroom life. The ways to change in teachers' practices are seen to be in how they connect and combine normative ideas and descriptive information. Thus, reflection is seen as a core concept in the attempt to bridge the divide between these two aspects. The model is based on a perspective that sees ideas never working directly on teaching, but "through those teachers that will transmit them into practical activity". It is emphasised that in order to understand this "a

phenomenological perspective is necessary". It is further emphasised that "it is not sufficient to explain life in the classroom only referring to the activity inside the classroom walls". The conflict is acknowledged between the responsibility to take care of individual students' personal needs and development on the one hand, and on the other hand to comply with national and international demands for increased productivity and economic growth. A key aim of TE is seen as developing student teachers' ability to develop themselves as professional practitioners, and not only "the ability to reproduce teaching from given models". Imsen highlights the significant impact that the work of Lawrence Stenhouse has had on educational developments outside the UK. Action research is seen as a powerful alternative to the "Tyler-rationale and the belief that schools can change only by formulating objectives". This alternative is seen to be through "the teachers' continuous evaluation of their own practice, reflection on their own experiences and the ability to learn from their own mistakes and successes". Attention is also drawn to research that highlights a distinction between those who investigate teachers' planning as a purely rational and logical concern (for instance in connection with management by objectives and implicit norms about effectiveness) and those who consider feelings and caring attitudes towards their students. From a theoretical perspective, the relation between the normative and the descriptive aspects of didactics is seen as one of the most important challenges for the future of teacher education.

Pertti Kansanen and Matti Meri deal with the didactic relation in the teaching-studying-learning process in chapter 8. The relation between general didactics and subject didactics is first analysed and the special characteristics of subject didactics are highlighted. Didactics is seen to be connected with some content in society and a curriculum restricts the degree of freedom to act in this context. Pedagogy is seen as the totality that guides the instructional process according to the aims and goals stated in the curriculum. The term subject didactics is seen to be problematic and the question is posed "Why not content didactics (Inhaltsdidaktik)?" This raises the sub-question "What is content?" Accordingly subjects are seen as only part of the content of the whole. In exploring how independent the different sections of subject didactics may be, the German concept of *Bereichsdidaktik* is discussed. This approach combines related subjects into an area (Bereich) and is used in practice in Finnish teacher education. As in curriculum planning in general the position of subject didactics is seen to be political by nature and dependent on the educational policy in the society. This means that some subject didactics may come to an end or change character with societal developments. The position of subject didactics is seen to be not a simple one and although content is recognised as important, subject didactics is seen as only one of a number of perspectives that are needed. The didactic triangle in the tradition of Herbart is used to discuss the complex relations between teacher, student and content. The pedagogical relation between the teacher and the student is taken as a significant starting point, in the *Geisteswissenschaft* pedagogy. In considering the relationship between the teacher and the content, the teacher's competence is brought into focus. From the point of view of subject didactics the question is one of balance between subject knowledge and pedagogy. It is noted that in principle the competence of the teacher is never too high but that "when it is beyond what is necessary (in terms of subject knowledge) it may be of no use". Further it is argued that in the traditional understanding of the didactic triangle, the content has meant discipline-based content knowledge but that this should be expanded to cover questions relating specifically to the curriculum. It is observed that teaching in itself does not necessarily imply learning and the preferred term for the activities of the students is that of "studying". It is through studying that the instructional process can be observed, whilst the invisible part of this relation may be learning. The teacher's key task is seen to be in guiding this relation. It is emphasised that the didactic relation is a relation to another relation and that to concentrate on this aspect is "the core of a teacher's profession". In view of the complexity of this aspect, it is observed that "it is difficult to think that the didactic relation could be organised universally or according to some technical rules". Consequently teachers' own practical theories and pedagogical thinking are seen to be of vital importance.

Writing from a Finnish perspective in which TE is included within the university system at every level, S-E Hansen and C-G Wenestam identify two central dimensions of teacher education in chapter 9. The first one is defined by the applied work that is carried out by teachers in their day to day practice. The second aspect is the knowledge formation that gives the understanding of the nature of teachers' work. They propose that it is the latter dimension that should be founded on scientific principles but that in general internationally teacher education does not offer the scientific training that is seen as fundamental to a profession. The dualistic nature of teacher education is seen to raise problems and difficulties with regard to what should be included. They argue for two principles that should govern teacher education. Firstly is the proposal that teacher education is an academic scientific discipline, in the same sense as for the medical profession. The implications of this approach are that the foundations for the education of student teachers must be scientifically based on scientific knowledge. It also implies that teacher education is a scientifically defined area where knowledge can be accumulated. They argue that this contradicts to some extent the apprenticeship model of teacher education. According to this perspective, the question of what knowledge is needed in teacher education and how knowledge can be accumulated is of central interest. The second key principle to govern teacher education is the importance of educational research and the close relationship between research and teaching in Finnish departments of teacher education. They draw on Kansanen's ideas in proposing that the kind of reflective thinking that teacher education is trying to promote starts from a research-based approach, which is aimed at permeating the whole of teacher education. The research-training element is intended to enable the student to acquire an understanding and way of reasoning about education in terms of its scientific qualities. They propose that this should result in students being able to discuss and argue by referring to scientific knowledge about educational practices rather than relying on "everyday thinking and magical or mystical arguments".

Section 2
Specific Subject Didactics

In chapter 10 Birgit Pepin discusses epistemologies, beliefs and conceptions of mathematics and its teaching and learning. In particular she addresses the theory and specifically how teachers' beliefs and conceptions are manifested in their practices by drawing on a recent research study in England, France and Germany. The chapter begins with an exploration of the issues raised in the literature concerning epistemologies, beliefs and conceptions of mathematics and its teaching and learning. Secondly, it analyses the ways in which mathematics teachers' classroom practices in England, France and Germany reflect teachers' beliefs and conception of mathematics and its teaching and learning. The findings of the research study suggest that teachers' beliefs and conceptions are manifested in their practices and can be traced back to philosophical traditions of the three countries, to epistemological and educational trends of mathematics and mathematics education, and to personal constructions. It is suggested that teachers' pedagogical styles are a personal response to a set of assumptions about the subject and its teaching and learning, to a set of educational and philosophical traditions, and to a set of institutional and societal constraints. Thus, it is argued that teachers' pedagogies need to be analysed and understood in terms of a larger cultural context and in relation to teachers' conceptions and beliefs, and that a lack of such understanding is likely to inhibit the process of change at all levels of the system.

Mathematics education is also the focus of chapter 11 by Brian Hudson, Hans-Jorgen Braathe, Sigmund Ongstad and Birgit Pepin. This chapter outlines the rationale for the development of the module on Mathematik Didaktik as a part of an electronic web-based "text book". The overall approach to the development of the module is based on a model of teaching-learning as an "integrative transformative science" with reference to the contribution by Friedrich Buchberger and Irina

Buchberger in this publication. This model pays due attention to the general aims of society as well as to curricula, content and learning situations. As part of this perspective, teacher competence is broadly conceptualised in terms of "professional action structures" in contrast with the narrow emphasis on technical competence and on mechanistic conceptions of a 'technology of teaching' that currently prevail in some parts of Europe, such as that outlined by Reynolds. The teaching-learning approach is based on problem-oriented, research-oriented and co-operative learning processes. Two fundamental beliefs about mathematics education underpin this chapter. The first of these is that there are three crucial elements involved: the mathematics, the teaching and the learning, or alternatively, the content, the teacher, and the learner. However these three elements only make sense in a mutual triad where no aspect should be given primacy. Secondly teaching-learning is seen fundamentally *as* communication. Underpinning the development also are particular ideas about the nature of mathematics itself. In relation to this aspect the starting point for the development is around "big ideas" in mathematics – in contrast to the fragmentation that is evident in the thinking of some policy makers at this time.

Chapter 12 by Alberto Bargellini focuses on the development of provision, in terms of the contents and methods, of the programmes of pre-service and in-service teacher education of science teachers at the Italian compulsory school level (primary school and middle school: pupils between 6 and 14 years of age). Particular attention is given to the educational strategies and didactical methodology on which this development is based. Integrated approaches to science teaching and their implications for programmes of teacher education are discussed. It is argued that though "we could easily be encouraged to think of content as the main integrating principle" many topics in science are "by their very nature interdisciplinary". It is suggested that content does not necessarily constitute the only possible integrating element. For example the same function can be carried out by "common pedagogical objectives" across subject boundaries or through "the adoption of a common methodology, based for example on the acquisition of concepts and the activation of procedures that are basic to experimental sciences". The profile of the mathematics and science teacher is outlined. A thorough knowledge of the structure, the didactics, the history and the specific epistemology of the two main subjects are seen as key components that go to make up a significant general reference model.

Sigmund Ongstad presents ideas about the challenges of generalising school disciplines and their didaktik across borders of languages and cultures in chapter 13. These are illustrated mainly with examples from mother tongue education, although examples from other disciplines (e.g. science) are referred to also. Examples and perspectives reflect the Norwegian and Scandinavian contexts in particular. The stance taken is "to try to avoid seeing a discipline as a straightforward phenomenon". It is emphasised that in this chapter there is no intention to cover all relevant problems, but rather to focus on the internal relationship between a discipline and its didaktik. One hypothesis is that defining a discipline is the moment of birth for its didaktik. Further it is argued that through the inevitable "languaging" of this ongoing process, an important relationship between the didaktik of mother tongue education and other disciplines and their didaktik is established. However this relationship is not seen to have been well recognised in general. With reference to the work of Bourdieu and Lash, ideas on the relationship between positioning, language, meaning production in society and didaktik are discussed. Drawing on post-modern thinking it is argued that "Language can no longer be trusted, but has still to be used. Language is seen as ambiguous. Languages, or rather semiotic signs, are now more economically important for the production than the traditional, manual act. The production, selling and buying of signs are economically more important than the 'unproductive' reproduction of the past". The didaktik is seen to be "sent in all directions to get order in or get sense in the blurred mess". It is argued that the discipline accepts paradoxes and that "we are in postmodernism". Accordingly the internal challenges in the didaktik of mother tongue education are seen to have the potential to serve as a source of reference for other disciplines.

The focus of chapter 14 by Aud Marit Simensen is on paradigm shifts in foreign language didactics. In this chapter she discusses the problems created by shifts of paradigm. This is discussed firstly in relation to theories of language learning and theories of language, sometimes referred to as the academic "parent" disciplines of foreign language didactics. Secondly these are related to theories of foreign language teaching, most often referred to as foreign language teaching methods. The problems are discussed from the point of view of educating teachers for a career across shifting paradigms. Above all Simensen questions the prescriptive aspects of foreign language didactics in teacher education and argues for a greater emphasis on analysis and criticism. It is argued also that there should be an emphasis on providing the students with an historical perspective on foreign language teaching and with the underlying theoretical rationale for different approaches to foreign language teaching over time, including different "versions" of foreign language school subjects. The "panacea fallacy" is seen as a phenomenon in foreign language teaching that should be avoided in teacher education. The priority is seen to be in preparing students better for the changes or major shifts that inevitably will come during their career as teachers. With this in mind, an important function in teacher education is seen to be in explaining new theories, concepts, ideas and teaching methods. However theories in teacher education should not be primarily for prescriptive purposes. Rather they should be for descriptive and consciousness-raising purposes and classificatory purposes. A good historical perspective on theories is seen to be essential in contributing towards "vaccinating our students against believing that the new ideas etc. will solve all our problems". It is seen as crucial that the theories students encounter in teacher education are not presented as the whole truth. A vital role of teacher education is seen to be in cultivating some of those intellectual virtues such as "a distrust of dogmatism and a healthy scepticism to accepted truths at any time".

In chapter 15 Folke Vernersson and Lars Owe Dahlgren discuss the use of models in social science and civics teaching. The chapter draws on experience gained through a research project on instructional models in civics and their application in teacher education with special regard to the upper parts of the compulsory and secondary school. Models are seen as providing simplified and formalised pictures of reality. Within the disciplinary context, models can function as "generative links between empirical studies and prevailing theory". In a didactic context, the function is seen to be "a more pragmatic one – to assist the teacher in teaching situations". The value of models in teaching is seen to be in giving "hints concerning the important issues of selection and communication of the subject matter". The concept of a model is central to the discussion in this chapter. The empirical aspects draw on the experimental activities of a group of student teachers. The students' projects are seen to provide "useful experience and deepened empirical knowledge". Finally, two main strategies for the use of models – the deductive and the inductive – are discussed. The deductive approach i.e. a method by which conclusions are logically dependent on the premises at hand leads to assumptions made from various models or theories being tested by empirical observations. In general it is observed that deduction is common in mathematics and in the sciences and that in practice, deductive teaching strategies combined with a high degree of teacher influence are probably quite common. When this kind of teaching is characterised too much by the teacher's personality, without consideration of the students' preconceptions, it has normally been classified – and criticised – as traditional transmission teaching. Inductive strategies on the other hand are seen to aim at having the students independently formulate and analyse issues in society. The goal is to arrive at personal models or "theories" which later may be tested against reality. This strategy is seen to be well established within teacher education in Sweden. It is suggested that the two strategies probably do not occur very often in pure, refined versions. The choice of strategy is seen to be dependent on the nature of the goals in the final analysis and will reflect conceptions about the nature of scientific research and knowledge. It is also posited that "didactical reflections lead to an enriched, enlarged and possibly changed perspective on science itself".

Section 3
Interdisciplinary Issues

Jaroslava Vasutova discusses issues in teacher education arising from a recent interdisciplinary workshop on pedagogy in the Czech Republic in chapter 16. The focus of the workshop was that of disciplinary didactics (subject methodology/Fachdidaktik) in teacher education. Participants were drawn from faculties of education and other university faculties which offer teacher education programmes in the Czech Republic. The keynote questions addressed in the workshop were:

1. Is disciplinary didactics (subject methodology/Fachdidaktik) regarded as a scientific field and what are the arguments?
2. Does the curriculum of didactics reflect the changing social and educational context?
3. How is didactics participating in preparing of students for the teaching profession?
4. What is the relationship between general and disciplinary didactics in teacher education?
5. What is the status of disciplinary didactics in professional and academic disciplines in teacher education?

The discussion centres on the sciences of education and their place in teacher education. It is noted that after 1989, as a result of political and social changes, the sciences of education were "immediately de-ideologized" and the disciplines which were suppressed such as comparative education and the sociology of education began to develop. Didactics as disciplines of the teaching profession are seen as deserving of special attention, given the significant impact they make to the formation of professional competencies for teaching. The roots of general didactics are traced back to the last century and in particular to Komensky's general theory of teaching and learning. The roots of disciplinary didactics also go back to the last century when "methodics as normative guides of how to teach various subjects were formed". Their development as a scientific field of education is a more recent phenomenon and various "concepts" (of disciplinary didactics) that have developed over recent years are discussed. Particular attention is given to the "communicative concept" of disciplinary didactics. This is seen as "a specific process of transformation, transmission and delivering of scientific knowledge of a certain scientific discipline through education towards individuals and society". Disciplinary didactics is considered as a "boundary discipline" with interdisciplinary character. It is seen to have its own subject and utilises the methodology of the sciences of education. The subject of disciplinary didactics can be characterised as a "specific form of communication of a scientific/artistic field with the subjects/objects of education". The teacher is seen to have a major role in terms of social interaction and "pedagogical communication" in introducing the scientific/artistic concepts "within the conditions of school teaching/learning". Given the interdisciplinary character of disciplinary didactics, "educators of this discipline" are seen to require interdisciplinary knowledge and concern is expressed about the status of "disciplinary didactics educators". Finally disciplinary didactics are seen as "young sciences" that have great potential in relation to the professionalisation of teachers.

Ana Isabel Andrade, Luis Marques and Nilza Costa outline an integrated approach to subject methodology from a Portuguese perspective in chapter 17. They also discuss the results of a preliminary evaluation of the experience of this development. They argue for the importance of a competence-based approach in initial teacher education but stress the danger of over-emphasis on skills and techniques. They support the view that what informs performance is as important as performance itself. Accordingly competence is characterised as a wide issue that encompasses intellectual, cognitive and attitudinal dimensions, in addition to that of performance. Some competences are seen to be person-related and others task-related. Therefore statements of competences should seek a combination of these two aspects in the light of the view that the processes

of personal and professional development are seen to be inseparable. The importance of language and communication is stressed, as is a constructivist perspective on student learning. The overall approach to this development is based on the view that there is "a theoretical body of knowledge working as a common denominator across" all the subjects involved (science, mathematics and humanities). Action, whether a part of teaching or any other activity in life, is seen to be either linked with theory or otherwise "it is blind and purposeless". Hence a theory of learning may be seen to function as an analytical tool in order to judge the quality of a particular teaching and learning event. A major aim of the methodology component is to help students to acquire a perspective on education based on "the achievement of autonomy, solidarity, ability for problem solving, reflection in action, democratic attitude, rather than a set of procedures that replicate previous knowledge and behaviours". The overall development based on the assumption of "a common body of knowledge in the field of Didactics" won widespread support from the students in the evaluation of the module. The evaluation is discussed fully in the concluding comments and it is also noted that the integrated approach was also an attempt to avoid a reductive understanding in relation to their own subject area whether in the field of science or language.

In an associated discussion Isabel Alarcão, Nilza Costa and Helena Araújo e Sá discuss the role of subject didactics in teacher education in chapter 18. They introduce the discussion with a clarification of the meaning of didactics and identify three interrelated dimensions. Firstly it may refer to research on teaching and learning which is seen as the research component of didactics. Secondly it may refer to what teachers do when they teach which is referred to as the professional component. Thirdly, consideration is given to didactics as a learning course of study in teacher education programmes and this dimension is called curricular didactics. It is noted that the field of didactics in Portugal has evolved from a practical, normative field of instruction to an inquiry-based, meta-disciplinary area of teacher learning, professional practice and research. General didactics have tended to be replaced in teacher education programmes by subject-specific didactics, though a need for a common core of knowledge is still recognised. The search for the identification of an "innovative self-defining idea based on an epistemological definition of the discipline contours", associated with a careful staff development policy are highlighted as key issues for the development of a "distinctive change-oriented self, a specific professional culture and an emerging body of knowledge". The development of a research unit, integration of research, advanced training, development of students' constructive and reflexive learning processes and collaboration with practitioners in schools all proved to be relevant issues. The search for the answer to the question about the role of subject didactics in teacher education was central to the success of the development. The epistemology of subject didactics is seen to have "revealed it as a field of generation of new knowledge that goes beyond subject disciplines and the so-called sciences of education". It is seen to subsume the common dimension of teaching (general didactics) and to interrelate this to the content dimension of teaching. Its integrative, interdisciplinary nature is seen to have "brought to light the mediating role of the teacher in the pupils' approach to content knowledge. The underlying focus on research concerned with what teachers and pupils actually do and say in their interaction in learning situations has represented an attempt to relate knowledge and action". The involvement of teachers in research projects "is seen to have helped to turn didactics knowledge into professional innovation".

In the final chapter Eila Jeronen and Esa Pikkarainen discuss the role of subject didactics, general didactics and the theory of pedagogical action in relation to the problem of overcoming the gap between theory and practice in subject teacher education. This gap between what is taught in the university and actual instructional action has been identified through many studies. An associated problem is seen to be the link between educational studies and studies in sciences. However, school practice and studies of subject didactics are seen to have been integrated better with the contents of subjects. The greatest problem in pedagogical studies is seen as enabling students to "construct a

holistic view of the structure of educational action". As a consequence the teacher education curriculum was re-orientated around a general perspective on the concept of "pedagogical action" from within the German tradition of Allgemeine Pädagogik. With reference to Benner, the idea of pedagogical action is seen to form the core in education and is based on the four principles. The first principle "Bildsamkeit" refers to the initial ability of the student to learn and develop herself. The second principle "Ausforderung zu Selbstätigkeit" means that educators act themselves in the way that later on requires the student to realise his/her ability. The third principle is "Contextuality" and involves coming to know the cultural context and acquiring the competencies that are needed in this context. The fourth principle is "Bildungs Ideal" which involves thinking about the future that is aspired to and the competencies that are needed for the students to improve their own contexts. These pedagogical principles are seen to have a dual role in the development of teacher education. They form the basis of the structure of the curriculum, and also should form the basis of methodology of teacher education. According to these pedagogical ideas, the teacher educator is seen as a guide who plans and arranges learning environments where the student teacher can find and develop his/her teaching abilities and skills. It is important to conceptualise student teachers' own experiences with reference to educational and didactic theories. The structure of the curriculum is aimed at bridging educational theory and practice and at trying to "bind together special and general tasks of didactics in every level of study processes". From initial evaluations this structural reform is seen to have helped students to "see their studies as a whole where theoretical and practical, general and special knowledge are integrated with each other". It is observed that students have acquired a better understanding of how the theory of subject didactics can be applied in the teacher's work. In the future, a greater emphasis on subjects is seen to be necessary alongside the development of subject didactics together with subject departments and schools. More research and development on general questions of pedagogy and didactics is seen to be necessary.

The lack of debate about Didaktik in British and American literature has been highlighted by Pertti Kansanen. The reasons for the separation of the traditions of Deutsche Didaktik and Anglo-American curriculum theory can be seen in relation to very different political and ideological circumstances during the twentieth century within Europe especially. Helmut Seel points to the need for a continuous evaluation of the dynamic relationship between general didactics and subject-matter didactics. Friedrich Buchberger and Irina Buchberger see potential for ideas contained in this publication to serve as a contribution to the constructive empowerment of the teaching profession and also to a reduction of the dependency on external and political control. With the support of the European Commission through the SOCRATES Programme of Directorate Generale XXII "Education, Training and Youth" it is hoped that this publication will make a significant contribution to re-opening, extending and enriching these crucial debates at this time.

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"Allgemeine Didaktik" ("General Didactics") and "Fachdidaktik" ("Subject Didactics")

Abstract

This chapter discusses the relationship between "Allgemeine Didaktik" (General Didactics) and "Fachdidaktik" (Subject Didactics) and draws particular attention to the importance of the conception of "Bildung" in German pedagogy. With regard to Bildung this is seen to be central to the "anthropological basics and foundations" of educational sciences ("Erziehungswissenschaften"). The chapter discusses the nature of Didaktik which can be seen as the science whose subject is the planned (institutionalised and organised) support for learning to acquire Bildung.

Introduction

Educational sciences ("Erziehungswissenschaften") form the anthropological basics and foundations of German/Austrian teacher education in which a good deal of the professional knowledge for teachers is traditionally represented and taught in the field of "Didaktik". Recent developments in teacher education have released a discussion on how to reform and redesign programmes. In this situation there seems to be an urgent need firstly, to develop "Fachdidaktik" as disciplines of specific research and theory, and secondly, to clarify the relationship between "Allgemeiner Didaktik" and "Fachdidaktik".

To initiate discussion some opinions are presented. It is hoped that they will initiate critiques and proposals for amendment and supplement, or raise resistance and opposition.

The word "Didaktik" is not commonly used in English educationists' language. A broadening discussion has taken place in the last decade to clarify the appropriate translation of this term (cf. Kansanen 1995).

The special meaning of the German word "Didaktik" cannot be understood without reference to another special concept of German pedagogy, that of "Bildung". Some remarks on the anthropological basis and foundation of education seem to be unavoidable. It should be a matter for discussion whether the English words 'formation' or 'erudition' (cf. Kansanen 1995, Hopmann 1992) are appropriate translations of "Bildung".

Anthropological basics and foundations in educational sciences ("Erziehungswissenschaften")

Human beings are born into a culture, a cultural environment, including a social system. Human personality is developing and shaping in a lifelong process. This development encompasses physical

learning processes in interaction (maturation and decline) as well as psychical learning processes in interaction with other human beings and in dealing with cultural phenomena such as objects, institutions, ideas, sciences etc. The acquisition of, and dealing with, cultural objects may be conceived as a major part of "Bildung" as a process, which represents a cluster of learning processes. I will use the German word.

The concept "Bildung" may also be conceived of as an (intermediate) actual state in the process of personality development. In this sense "Bildung" may be seen as the subjective state of becoming a part of the culture.

The learning processes are supposed to lead to an integration of knowledge and rational thinking (as a basis for the competence to judge), of volition (as a prerequisite for the readiness and ability to decide) and of competence (conceived of as capability to act in an efficient and responsible manner in social terms). In this meaning "Bildung" may be seen as an ideal norm. In this perspective theories of "Bildung" (cf. Derbolav 1970, Klafki 1963) talk about a connection of "materiale Bildung" and "formale Bildung" to a concept of "kategoriale Bildung".

Those processes of learning, which in their entirety represent the process of "Bildung", receive their impetus from dealing with people and experiences with objects. They occur occasionally and may be seen as accidental and disordered. In more complex and developed societies and cultures these learning processes are viewed as insufficient to help (young) people to become responsible and competent members of society in the sense of educated personalities ("Gebildete"). It then seems necessary to establish institutions and professions which have to promote organized, designed learning processes. Spontaneous and situational learning has to receive support and be supplemented by planned intentional teaching.

The promotion of learning processes, relevant to acquiring "Bildung" by teaching, relates to two components:

(i) selection and provision of cultural components as goals and content of learning
(ii) support for learning processes as regards their efficacy and success

The overall aim may be defined as the educated personality ("Gebildete/r") described above. In modern democratic societies this aim may be specified as follows:

(i) in an egalitarian sense it has to apply to all citizens;
(ii) as regards content, it relates to central problems of living and
(iii) is relevant to everybody and may be called "key problems" ("Schluesselprobleme");
(iv) as regards the human potential it relates to all human capabilities (cf. Klafki 1985)

This leads to the concept of "Didaktik", which may be understood as the science whose subject, whose topic, is the planned – that means institutionalized and organized – support of learning to acquire "Bildung".

Some reflections on the concept "Didaktik" ("Didactics")

"Didaktik" ("didactics") may be conceived as the science whose subject is the planned (institutionalized and organized) support of learning to acquire "Bildung". "Didaktik" may be concretized in relation to different institutional contexts (cf. Schulze 1993). In this paper it will be

related to the learning formation "school". "Allgemeine Didaktik" ("general didactics") of teaching in schools deals with the following topics:

(i) problems of the pedagogical aims and objectives as well as task areas of the institution or school in particular social contexts
(ii) given conditions and available means to reach defined aims and objectives
(iii) problems of learning under the institutional conditions of school

Formation/Erudition

PROCESS	STATE	STANDARD
Cluster of learning processes developing human beings to members of culture and society (personalities)	Intermediate actual state in process of personal development "status of being in culture"	Accepted and performed status of personality in a specific culture and society
Support by living together with experienced members of society	⟷	Imagination of an able member of an esteemed society
Organised fostering by teaching institutions professions	⟷	Elaborated description of ideals
	"Didactics" science of teaching under conditions of school aiming to foster formation of pupils of different ages	

Figure 1

A theoretical approach towards "Didaktik" based on theories of learning suggests the adaptation of teaching to the learning processes of students. Based on knowledge of psychological processes of learning, this approach aims at analysing and detecting those teaching procedures which seem to be most appropriate to promote the learning processes of students (cf. Aebli 1983).

Contrasting "natural learning" and "learning in the institution school" some problem areas of "Didaktik" may be outlined:

LEARNING

natural		*institutional*
(emerging spontaneously)		(organized artificially)
real, current	NEED	constructed, fictional
detected by chance	CONTENT	predetermined
spontaneous	PROCEDURE	influenced
individually	PARTICIPATION	collectively
proven	SUCCESS	assessed
used	OUTCOME	stored

Figure 2

"Didaktik" may be specified in relation of different institutional contexts. On this occasion it will be related to the institution school. "Allgemeine Didaktik" of teaching in schools deals with the following problems:

(i) Selecting content to be learned
(ii) Providing learning occasions
(iii) Structuring learning procedures
(iv) Providing opportunities to participate in learning for every individual student within the class
(v) Giving feedback on learning outcomes
(vi) Ensuring learning outcomes
(vii) Preparing transfer of learning

"Spezialdidaktiken" ("special didactics") of teaching in schools may relate to problems of teaching in different types of school, to particular age levels of the students or to specific domains of content (subject disciplines). A major type of specialization may be called "Fachdidaktik" ("subject didactics").

"Didaktik" as a theory of teaching at school has to deal with problems of content and procedures of teaching in the classroom. A theory of syllabus ("Lehrplantheorie") – I avoid the use of the word curriculum – may be situated in the centre of questions on

(i) Legitimisation and structuring of learning areas
(ii) Selection and definition of learning goals and learning subjects

- Foundation of responsibility for man and world
- Possibility of fundamental experimental experiences in important dimensions of culture and nature
- Initiating and supporting of problem solving learning processes
- Fostering abilities in independent thinking, judging, deciding and acting

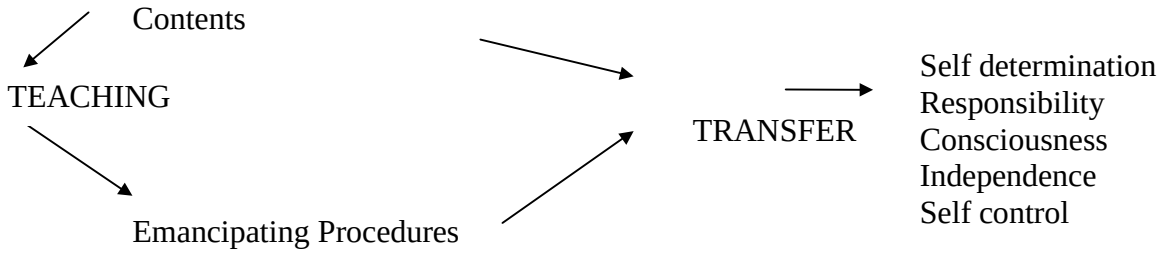

Figure 3

Tasks of "Allgemeine Didaktik" traditionally focus on problems of content of teaching and problems of procedures of teaching. The principles of prototypical ("exemplarisch") learning and of genetic ("genetisch") learning are of major importance in this context.

Teaching which aims to foster, to advance, to support, the process of "Bildung" under the conditions of school as institutional framework is the topic of "Allgemeine Didaktik".

Two problems on the procedures of teaching seem to be substantial:

(i) How has the process of teaching to be structured so that students find optimal conditions for their learning? It seems to be necessary to find structures or "gestalt" of teaching based on and compatible with structures or "gestalt" of (active) learning.

(ii) How have learning situations in the social context of a classroom to be arranged, so that students find ample opportunity for individual and active learning? An optimal support of the learning processes of each student by the teacher may be defined as the aim of these efforts. A balanced relationship between autonomy of the learner and external guidance by the teacher has to be found.

Following gestalt-psychology, learning processes of students may be conceived as problem-solving processes, which have to be evoked and guided. Learning as problem-solving may support intrinsic motivation and offers students opportunities to acquire procedures (methods, heuristics) relevant for learning at school and in everyday life. Students may experience the relevance of inquiry and research as well as thinking and reasoning. Teachers who arrange learning situations following a problem-oriented approach seem to fulfil the pedagogical goal of reducing the difference in competence between teacher and student and therefore of helping students to emancipate (cf. *To "Didaktik" based on gestalt-psychology* Roth 1957, Seel 1983, 1997, Winnefeld 1957).

The fields of studies and their educational impact

Some comments on "subject disciplines" (this term is used for the fields of studies in the school curriculum: "Unterrichtsfächer", and should be further discussed) will be helpful in this situation.

Subject matters within the syllabus or curriculum considered important for youth take shape in the form of subject disciplines. By means of these subject matters realities important for living in a particular society are represented. In this way the student acquires behavioural patterns and norms that make her/him a critical and productive member of society.

The selection of (content) areas, topics and the subject matters (disciplines) that are part of a school system, depends on the particular societal-cultural situation. The traditional educational canon of our school system is neither a historically compelling nor a systematically homogenous one nor is it a universal one with everlasting validity. It developed due to the interplay of cultural-historical tradition and current societal needs and is the result of a balancing of interests in the field of educational policy. How well these fields of studies (subjects, "subject disciplines") actually represent the fields of life has to be evaluated from time to time. "Subject disciplines" – even if they may have the same name – are by no means parts or extracts of sciences. They differ in goals and extent. "Subject disciplines" and modern sciences also differ in their particular aims and goals. In the following discussion the more common word "subject" will be used for "Unterrichtsfach".

The subject of Geography, for example, also includes contents from the fields of geology, mineralogy, meteorology, astronomy etc. This incongruity becomes even more evident if no science exists with the same name. The subject of Economics, for example, covers parts of economics, business, finance, economic policy, history of economics etc. On the other hand important areas of German, are not dealt with by the science "German philology". This means that subjects developed earlier than modern sciences. The teaching of languages in schools is still strongly oriented by the mediaeval trivium (grammar, rhetoric and dialectics), in any case more strongly than by philological sciences.

Subjects, in their original sense, are skills, "arts", or knowledge. They represent independent teaching material for the introduction to connections and codes of conduct important for life. Accordingly subjects and sciences also differ in their particular goals. Science aims at a complete and methodically appropriate comprehension of, and a systematic approach to, all facts within a defined reality. Subjects represent specific forms of encounter and dealing with important dimensions of reality. They aim at the opening up of certain fundamental experiences influencing behaviour. The fundamental

experiences can be defined as the educational impacts of the subjects as such. Subjects may be seen as selected knowledge and skills. They represent teaching complexes relevant for the introduction to life in culture and society.

Several different educational efforts can be united into a subject due to their mutual aiming at a particular fundamental experience. An example: the educational impact of the subject Geography can be seen in the imparting of the fundamental experience that everywhere in the world people are forced to deal with factors like soil, landscape and climate to guarantee life. To reveal this basic experience is a major task in the teaching of Geography. Subjects in this sense can be interpreted as "fields of concentration of methodological work". As long as a certain subject and a special science within certain limits deal with the same topics, they do it in different ways and with varying goals. These goals are, on the one hand, determined by the higher purpose of specialized research and, on the other, by the comprehensive character forming of the students.

Only by means of establishing relations towards the human being and her/his life in nature and society does a topic turn into a subject of teaching. This important feature is emphasized by the educational impact of the subject discipline. The fundamental experiences themselves cannot be tested as results of teaching nor be assessed by grading. The existence of relevant knowledge does not guarantee that these very insistent and educationally efficient basic experiences can be achieved. As non-operational and non-controllable learning objectives they can only indirectly be strived for by means of appropriate instruction. The educational efficacy of any subject is reflected in its contribution to the development of the realm of responsibilities under which a human being has to learn, to take decisions and to perform. Even though subjects in this sense cannot be understood as diminutives or preliminary stages of sciences, school still works on the principle of an orientation towards science. The purpose of schools is to equip us with the necessary tools to function in a scientifically dominated world as well as to foster the ability of keeping a scientific distance from essential prerogatives of our society. In detail, this corresponds with four tasks:

(i) Acquisition of scientifically secured knowledge
(ii) Competence for communication and cooperation
(iii) Competence for critical reflection
(iv) Competence for lifelong-learning and permanent revision of knowledge.

In other words, the scientification ("Verwissenschaftlichung") of all areas of life leads to the following consequences in the sector of general education ("Allgemeinbildung"): continuous questioning of the known, openess to new knowledge and flexibility as well as the readiness to deal with change.

On "Fachdidaktik" ("subject didactics")

"Fachdidaktik" ("subject didactics") represents a scientific discipline dealing with the following tasks:

(i) Constitution and legitimization of a subject ("subject discipline") as a contribution towards achieving the general educational goal of school (not all sciences are represented among the subjects taught in school)
(ii) Selection of educationally relevant content and its structuring
(iii) Assurance of the standard of the academic quality of issues mentioned before ("orientation on sciences"/"Wissenschaftsorientierung" of subject disciplines)
(iv) Development of subject-specific procedures for teaching/learning
(v) Evaluation and securing of results of learning in the context of results of "Allgemeine Didaktik"("general didactics")

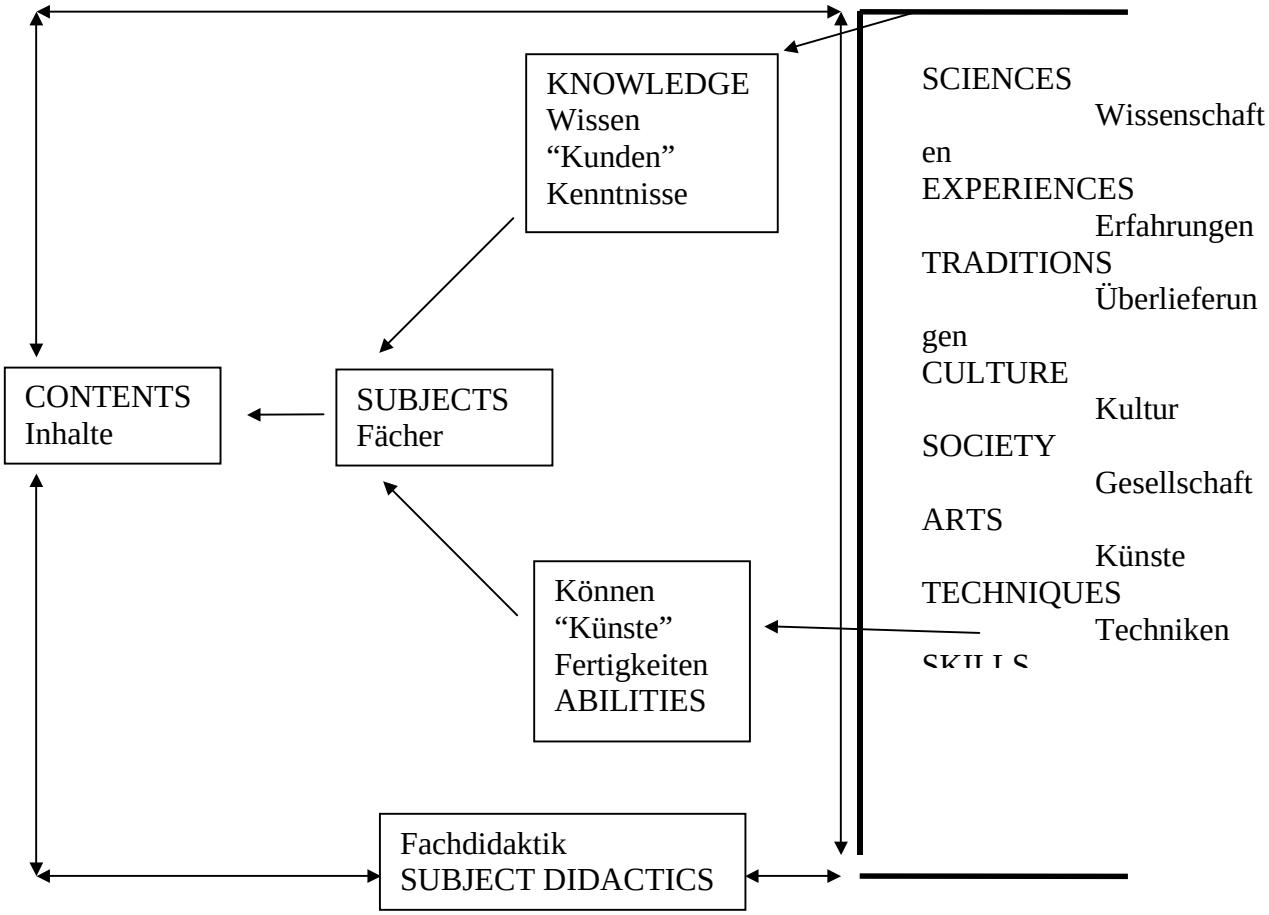

Figure 4

"Fachdidaktik" ("subject didactics") should be regarded as the relevant discipline in initial teacher education at colleges of teacher education and at universities. It seems to be indispensable that "Fachdidaktik" ("subject didactics") has the opportunity to exercise influence on those academic disciplines providing academic knowledge relevant to teaching particular subjects. This influence seems to be necessary so that the needs and expectations of initial teacher education (e.g. selection of topics and methods) can be met adequately by the programmes of the other academic disciplines. If the other academic disciplines are not in a position to provide adequate programmes, they have to be developed by "Fachdidaktik" ("subject didactics") additionally and independently.

The relationship between "Allgemeine Didaktik" ("general didactics") and "Fachdidaktik" ("subject didactics") and their influence on the teacher education programme

Figure 5 demonstrates the structure of the programmes in both fields:

Allgemeine Didaktik	**Fachdidaktik (subject didactics)**
1. Matters relating to the teaching process Learning under conditions of school * teaching process * arrangements of classroom interaction * media * evaluation	1. Matters relating to the teaching content of subject teaching * educational purpose of a subject * science-subject relationship * syllabus of subject * subject matters and content * learning objectives

Materials	Fachdidaktik (subject didactics) Formation
2. Matters relating to the teaching content	2. Matters relating to subject specific teaching processes
* general education ("Allgemeinbildung") as task of school *subject disciplines as areas of learning * canon of subject disciplines * principles of teaching * theory of syllabus * lesson planning	*teaching structure and process * teaching methodology * media * evaluation

Figure 5

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The *Deutsche Didaktik* and the American Research on Teaching

Abstract

This chapter presents an historical overview of the development of the "Deutsche Didaktik" and compares it with the American tradition of research on teaching. This tradition is traced back to Johan Amos Comenius in the 16th century as a practical and normative doctrine and various trends within the 20th century are identified. The absence of almost any discussion of Didaktik in British and American literature is highlighted. In relation to this phenomenon, there is a discussion of how the traditions (Deutsche Didaktik/Anglo-American curriculum theory) separated in response to political and ideological circumstances. It is noted that reform pedagogy and new conceptualisations of Didaktik did not reach American education. In addressing the aspect of Fachdidaktik, it is argued that only erudition-centred Didaktik/Geisteswissenschaften has a clear position on this question. In essence the main task in this tradition is seen as a theory of educational content (Theorie der Bildungshalte) according to its value in the curriculum and in the instructional process. Finally some observations are offered on the Nordic alternative and the conflict between the different traditions of educational psychology/empirical research and geisteswissenschaftliche Didaktik/ hermeneutics is highlighted.

Introduction

My interest in *Didaktik* began in my early studies in the psychology of education and learning theories. All the textbooks were in English or in Swedish and the students of my generation got a very thorough understanding of the American way of thinking in educational problems and how to do research correctly. There was only one way: according to the method of science. In the late 1970s I found Wolfgang Klafki's book *Studien zur Bildungstheorie und Didaktik* in a book sale. I remember that I understood practically nothing of its content.

As a university teacher of the foundations of education one of my courses was about the basics of *Didaktik*. It was always confusing to use the concept of *Didaktik* without really knowing what it meant. I knew that it came from Germany but its content was from the American curriculum research or from American educational psychology. Although we co-operated with the IPN in Kiel when the curriculum research was at its peak in the 1970s the content of the *Didaktik* was in the background. At that time there was no need to get acquainted with the human sciences or *Geisteswissenschaften* or its method, hermeneutics.

Gradually, when general attention began to focus more and more on the theoretical background of the empirical models, the question of the nature of the *Didaktik* became of current interest. In Finnish teacher education *Didaktik* is the main subject and, because my chair represents teacher education, it became a personal problem to find an answer to the question *What really is Didaktik*?

It was not possible to find an answer from American literature or from German literature on curriculum research. After some conceptual analyses there was no other way to solve the problem than to begin to read German *Didaktik* books, among others the old Klafki. But it was not easy at all. In the Nordic university libraries you cannot find a sufficient number of German books, you must go to Germany. Luckily, in those German universities that I know the libraries are excellent. This literature opens a whole new world and you notice how it becomes possible to think differently about the same problems.

The background of German didactic models

The German *Didaktik* (*didactica*) was founded by Wolfgang Ratke and Johan Amos Comenius (1592–1670) at the beginning of the 17th century. Its idea was to develop a general method of teaching compared with the logical method which at that time was thought to be the best way to present the teaching content in order to bring about learning. *Didaktik* was a practical and normative doctrine by nature (*Lehrkunst*) and the best-known presentation of its early characterisation is *Didactica Magna* by Comenius.

The position of *Didaktik* with regard to pedagogics (*Pädagogik*) changed during the next few centuries. The work of Johann Friedrich Herbart (1776–1841) again brought the status of *Didaktik* to the centre of education, with his formal stages and with his principle of education through instruction. In his time *Didaktik* had a strong position as a science of education (*Wissenschaft*). *Didaktik* was mainly concerned with education at schools. Schools were practically the only places where organised education took place.

At the beginning of the 20th century *die Reformpädagogik* acquired its great representatives (Kerschensteiner, Gaudig, Petersen) with the main focus on child-centered activities. On the theoretical side, pedagogical thinking was dominated by *geisteswissenschaftliche Didaktik* (Nohl, Weniger, Klafki) until the early sixties when the empirical-analytic paradigm gained some ground (Heimann, Schulz, Otto). Thirdly, critical-communicative *Didaktik* offered an alternative based on critical theory and especially on the ideas of Jürgen Habermas.

In addition to these three theoretical models, in contemporary *Deutsche Didaktik* there are numerous minor variations and local versions. The development has brought the main models closer to each other as the theoretical background of the models has been analysed. *Die Didaktik* has also been in close contact with teacher education. By nature, *die Didaktik* in Germany has always been philosophical thinking, theorising, and construction of theoretical models.

The American tradition of research on teaching

The American tradition of research on teaching and on the problems of curriculum development is not as long as in Germany. It can be traced back to pragmatism and to its main representatives Herbert Spencer (1820–1903) and William James (1842–1910). The influence of John Dewey and William Heard Kilpatrick in particular has been great. At the same time, educational psychology, with Edward L. Thorndike, achieved its central position in research on teaching in the US. The fundamental interest in teaching was practical by nature.

The predominant approach to the problems of teaching has been research on teacher and teaching effectiveness. Along these lines there has been a series of model building from Mitzel, Dunkin and Biddle to Shulman (Gage 1963, Dunkin and Biddle 1974, Shulman 1986a). The purpose of this kind of thinking has been an attempt to find those teachers who could attain the best possible results

and to determine those factors which are crucial in planning and acting in the teaching process. In this way research is also connected with teacher education.

On the theoretical level, the development of theoretical models has concentrated on empirical research and on testing these in real situations. Mastery learning in particular, based on the ideas of John B. Carroll and Benjamin S. Bloom, is well known in this respect. Bruce Joyce and Marsha Weil have collected the various philosophical and psychological strategies and formulated applications to teaching.

Most of the research on teaching has been empirical and with quantitative methods. The latest developments, however, have led to alternative approaches. The most commonly used process-product-paradigm is not as dominant as it was earlier and studies with qualitative research methods have greatly increased. The theoretical background to the discussion of research problems is clearly research methodology which leads to other philosophical questions.

Some preliminary conclusions

Comparison of terminology

Die Didaktik – didactics

Didactics (*die Didaktik*) is a difficult term to use. Its origin is an applied translation from Greek meaning both teaching and learning (Heursen 1986, Knecht-von Martial 1985). Wolfgang Ratke and Johan Amos Comenius were the founders of this terminology and the first to launch the term in their writings, but *Didaktik* was an artificial term in a certain way. The respective family of words in Greek was not translated with a German word but with an application of the original *didáskein* via Latin *didactica*, which was also artificial. Its very first meaning was about the same as the art of teaching or *Lehrkunst*.

Die Didaktik was gradually taken into more general use alongside *die Pädagogik* or pedagogics, but its use was limited to German-speaking countries or to countries having cultural relations with Germany. As a result, *Didaktik* is nowadays in use in Central Europe and in the Scandinavian countries, but it is practically unknown at least in English- or French-speaking countries in the area of education. The very word can be found in dictionaries with quite different meanings, however. It is based on *didascalia* having the meaning of a didactic poem (Blankertz 1975, 14), and that makes its use most awkward and disturbing.

What then is the proper translation of *Didaktik*? (cf. also Kansanen 1987). If we emphasise the normative side of *Didaktik*, the most convenient descriptionwould be the art of teaching. This expression, however, already has its own context (cf. Gage 1978). But if we want to keep the definition as wide as *Didaktik* is nowadays, the art of teaching is too narrow because there is no reference to learning in its meaning. Naturally, there are various interpretations of teaching (cf. Smith 1987, including older references), but what is essential in this analysis is that *Didaktik* is at the same time a second order term. It is thus a model or a system of how to envisage the teaching-learning process as well as a kind of metatheory where the various models can be compared with each other.

If we emphasise the descriptive side of *Didaktik*, the research aspects come to the fore in its content. Then the proper expression would be research on teaching. If we look into the well-known research models of Mitzel, Dunkin and Biddle, and Shulman, the aspects of learning can also be seen there. The difference between the descriptive *Didaktik* and research on teaching is in their background or in the purpose of their model building. The first, *Didaktik*, is mainly meant for teacher education

and the models are based on a philosophical conception of man and on the nature of research concerning his/her education. The empirical research results are not a prerequisite for its building, but the results are used, naturally, in a corrective way when they are in conflict with the model variables. The second, research on teaching, is meant for research purposes and that's why the models are mainly inductive by nature and based directly on research results. Practical conclusions can be drawn from these models and thus they can function in teacher education, too.

Earlier, in the American research mainly based on empirical-analytical foundations, most of the research was conducted with the so-called process-product model. The picture has changed and alternative research paradigms can be found (cf. Guba 1990). At the same time, the philosophical foundations have become more versatile and the situation reminds us in many ways of the parallel state of affairs in Germany.

Looking at the same problem from the other side, we can pose the question of how to translate *research on teaching*. Here we can find an easy solution: it is *Unterrichtsforschung*. This translation makes it clear that the core is classroom research with a psychological or social psychological emphasis. The research problems are mainly empirical. If we now compare *Didaktik* and *Unterrichtsforschung* we notice essential and great differences in their use. First of all, *Unterrichtsforschung* is only part of *Didaktik* and with their comparison the different philosophical traditions come to the fore. Secondly, *Didaktik* is of genuine German origin. It is based on a philosophical tradition of its own with such names as Kant, Herbart, Schleiermacher etc. The different schools of *Didaktik* which exist in the German literature mainly refer to the German tradition. It should be noted that the more empirical elements in a model of *Didaktik*, the more references can be found to American research on teaching. The content of *Unterrichtsforschung* consists of empirical results; it is descriptive by nature and it is classroom research employing all possible means and, in principle, with different kinds of philosophical backgrounds.

I have also suggested that *Didaktik* can be found in textbooks of educational psychology (Kansanen 1987). Those books (e.g. Gage and Berliner 1984) have lengthy sections containing background material of a purely psychological nature, as well as clear normative sections. The psychology of education and *Didaktik* are linked together, being referred to as educational psychology. Teaching methods in particular are those parts in which the practical side comes under consideration. The theoretical references are to the theories of curriculum and that is why the analysis of the term *Didaktik* is not possible without considering the meaning of curriculum.

Curriculum – das Curriculum – der Lehrplan – die Didaktik

Josef Dolch (1959, 318–319) has pointed out the early use of the word *curriculum* in both German and English. In Anglo-Saxon educational literature it has remained since then in the terminology; in German it was displaced during the 18th century with the word plan and further with teaching plan (*Lehrplan*). It was the philanthropists who took the new term up and Herbart was already using it at the beginning of the 19th century.

The word curriculum came back into use in German during this century, in the late sixties (e.g. Blankertz 1975, 118–122). Through American influence, *das Curriculum* was taken into use as a better version of a teaching plan. It was Saul B. Robinsohn (1967) who introduced a new approach of curriculum planning with his book which at the same time was broader in its meaning than the former teaching plan (*Lehrplan*). The application of the term curriculum was based on the American idea of *Reformpädagogik* by John Dewey and its focus was on every individual pupil and his/her learning experiences. Herwig Blankertz describes (1975, 122) the differences between these two terms from the German point of view. The teaching plan had become more and more a plan for the

teacher of how to organise the activities when teaching a special subject and choosing the content within this subject. The new conception of the teaching plan *curriculum* concentrated on every pupil and his/her learning.

Thus, the curriculum was defined through the learning experiences, and common to various definitions was the focus on the individual pupil and the learning experiences which s/he was to encounter during his/her time at school (cf. Hosford 1973). If we take the broadest meaning of the curriculum, it consists of all the experiences organised during the time the school is responsible for the pupil. This also contains, by definition, such experiences which are not consciously planned but which are happening in the school. Thus, in this case there is no room left for the hidden curriculum because all the experiences are within the curriculum (cf. Jackson 1992, 4–12.).

Gradually, the meaning of curriculum was broadening and as curriculum theory, its scope was nearly the same as traditional *Didaktik*. The word, *das Curriculum*, was directly taken into use without any special translation and its content was becoming more and more the same as *Didaktik* with a particular emphasis of its own (cf. Frey 1971). Wolfgang Klafki (1974) wrote an article in a dictionary under the common heading "Curriculum – Didaktik" and it seemed that *Didaktik* would be subsumed under the more general curriculum. It was a radical interpretation of traditional *Didaktik* and it showed a certain change in thinking about the old subdiscipline of education. It was, however, only a question of how to compare these two aspects which were parts of the more general *Didaktik*. In this article Klafki described the old directions of didactic models and in addition to that, the aspects of curriculum planning and controlling or evaluation. So one can say that it reflected at least a different conception of the problems of *Didaktik* and it had great influence on practical curriculum development.

The research on curriculum problems concentrating on development, planning, and evaluation grew greatly during the 1970s and it reached its peak in the early 1980s. The results were reported in large handbooks (Frey 1975, Hameyer and Frey and Haft 1983): *Didaktik* and curriculum theory were considered as parallel areas of the same subdiscipline. During these years the emphasis was on curriculum theory and it had a very important role in the efforts to achieve school reform, and in particular in reforming the old teaching plans into a modern curriculum.

It is not easy to define the curriculum, and difficulties arise because curriculum as a concept has numerous semantic contents and nuances depending on the context in which it is found and on the purpose for which it is used. Reisse (1975) points out that the term curriculum is strongly culture-bound which is why comparison of its meanings across linguistic boundaries is fraught with a variety of difficulties. Additionally, of course, any term may also have several meanings within a specific cultural environment (cf. Connelly and Lantz 1985). The American influence of the implementation of the term curriculum can be evaluated from the point of view of planning and evaluation of education in institutes. The problems of formulating educational goals and objectives as guidelines for teaching practice were focused on, and methods of evaluation, both in the classroom and on the school level, became more important than before.

The question of the relationship between *Didaktik* and curriculum has gradually lost its interest and the status quo seems to have been achieved. The impulses have come from the American research, but there is hardly any evidence of impulses in the opposite direction. One could conclude that the didactic aspects of curriculum have integrated into *Didaktik*. Zimmermann (1986) is of the opinion that discussion can be reinstated because we now know the good and bad sides of the problem.

The independence of education as a discipline

The first independent chair of education was established at the University of Halle in 1779. The very first professor of education was Ernst Christian Trapp (1745–1818). His idea "*Versuch einer Pädagogik"* was to no longer base education on philosophy and theology but on the nature of man and on contemporary society. He also spoke about such modern research methods as observation and experience as a basis for conclusions. This professorship is considered as the start of an independent discipline and it is clear that it happened in Germany where there had been much educational thinking in the area of philosophy and theology. It took about one hundred years before independent professorships in education were established in England, Scotland and the US (cf. Sjöstrand 1967, Wulf 1977).

From the beginning, education was considered as an independent discipline with its own problems. The current classification of education can be traced back to the German tradition and there are certain differences between the German and the American way of classification. There are three or four common basic problem areas: education in general, the psychology of education and sociology of education. Usually, the classification must be made according to one criterion at a time, and this point can arouse some confusion. The most common criterion is the classification of disciplines. However, there can be such criteria as the content of education or the age of pupils etc. In a well-known German example (Röhrs 1969) general education consists of pedagogics and *Didaktik* (*Pädagogik und Didaktik*) and the latter is usually seen as a subdiscipline concentrating on the questions of teaching. General education is further divided into sub-areas using educational reality and the stage of life as criteria for the division. This leads to school education (*Schulpädagogik*), special education (*Sonderpädagogik*), pre-school education (*Pädagogik der Frühen Kindheit*), vocational education (*Berufspädagogik*) and adult education (*Erwachsenenbildung*). In addition to the basic classification, the history of education and comparative education overlap all the other areas.

In British educational literature there has been a consensus of opinion about the nature of education. However, Paul Hirst does not agree with the term *discipline*, he prefers to use the term *a field of study* (Hirst 1983; Tibble 1966). Lee S. Shulman also says the same: "…education is not itself a discipline. Indeed, *education is a field of study*" (Shulman 1988, 5). So there are some doubts about the status of education depending on the way we think of formulating its problems. At the same time, there are many aspects and many possible approaches resulting in various research methods which have their foundations in several background disciplines. That is why any attempt to make a systematic classification does not succeed without many simultaneous criteria.

In any case, in British as well as in American educational literature, the sub-area of *Didaktik* seems to be lacking. As we have seen earlier, much of its content belongs to educational psychology. In the American literature of research on teaching, the problems of teaching and learning in general are usually held together without any theoretical model building. Attention is paid to the methodological problems, and there the various background principles can be seen. In German educational literature, didactic problems define an independent subdiscipline of education which really is very much the same as general education, but, however, with its own point of view. The area of *Didaktik* is mainly larger than educational psychology and it includes much philosophical and theoretical thinking. In German literature *Didaktik* and educational psychology are clearly separate fields with different representatives. The situation in Great Britain and the US is quite the contrary; the same people are working in this common area. Naturally, there are differences as to the importance given to some aspects of the problems, e.g. the role of learning in the teaching process.

How the traditions separated

We know that at the end of the 19th century American educational research had many contacts with German research. Walter Doyle (1993) refers to the term *didactics* as he quotes Paul Woodring's text in the 1975 Yearbook of the National Society for the Study of Education with the astonishing remark that a chair of didactics was created at the State University of Iowa in 1873. We also know that John Dewey was a member of the first executive council of the *National Herbart Society for the Scientific Study of Education* that later changed its name to *the National Society for the Study of Education*. The texts of Hegel and Herbart were known to him and to other colleagues through translations. At the personal level there were numerous contacts and study trips and consequently the language of education was common to both.

Stephan Hopmann has analysed in depth the early history of German *Didaktik* and the common background of German and American *Didaktik* (Hopmann 1992). Although there were many contacts with Herbart's ideas and progressive education had its respective version as *die Reformpädagogik* in Europe, the contacts suddenly ended at the beginning of the 20th century. Hopmann (1992, 7) also remarks that there were, however, certain differences between the progressive movement and reform pedagogy; the latter emphasised teacher education and schooling whereas the former was more concerned with social change and politics.

Further, Hopmann (1992, 8) states that it was the educational psychology that the Americans (Hall and Dewey) took from Herbart, not the whole of *Didaktik*. The main reasons for the spread of *Didaktik* in Germany were the state guidelines for the curriculum and the system of teacher education in the seminaries (Hopmann 1992, 4–5; Hopmann and Riquarts 1992, 22). These required a central solution and central models of schooling problems in society. The criticism of Herbartianism that it was a mechanical application of the ideas of Herbart led to the reform pedagogy and through it to new conceptualisations of *Didaktik*. This new development did not reach American education and at the same time the word didactics disappeared from the terminology. That meant a different sort of development in both countries with amazing disparities.

Walter Doyle and Ian Westbury (1992, 138–145) explain the development of American education by referring to the structure of governance in the system of schooling. The local boards of education had the responsibility for the effectiveness of the schools and the role of the superintendent was central. The interaction between the school and the local community was very intimate. Although the individual states had constitutional responsibility, the control was merely a formality. In addition to these basic characteristics, the absence of church had many consequences in the curriculum and in practice. The model of teaching was the same as in business life: "They (teachers) were and are a labor force to be motivated and managed as any large enterprise's labor force was motivated and managed". (Doyle and Westbury 1992, 140). It is easy to see, I think, that the atmosphere was not very encouraging to independent and autonomous action. Accountability was always narrow and the local boards and public held direct control over the school and the teachers.

Instead of *Didaktik*, psychology of education took its place as a discipline of the science of education in the US. At the same time this line of research in Germany became separated from *Didaktik*, although there was at first a close relationship between them. Concerning this development in the US there is a certain important point that needs special attention. Doyle and Westbury (1992, 141) quote Ellen Lagemann as saying "one cannot understand the history of education in the United States during the 20th century unless one realizes that Edward L. Thorndike won and John Dewey lost". This can be seen e.g. in the well-known textbook of Robert M. Travers (1978) where Thorndike's position is central. Afterwards it is easy to say that this way of thinking was too fragmented and its behavioural and experimental features were too narrow to apply to the whole

process of education. This phase, I think, however, was necessary in the development of educational research. The defects are not to be found in the psychology of education itself but in the way it was applied over the whole field of education, without alternatives.

Empirical research can be done in many ways. Some of us do it without thinking of the philosophical assumptions behind the procedures. Some practical problem guides the thinking, and research methods are selected according to their practical value in finding solutions to the problem. In this example the awareness of the method has not been aroused and the way of doing research is self-evident and it is not problematised To follow the Kuhnian language, the action is happening inside the dominating paradigm where all researchers agree with each other. I think that looking at the problems of education through the glasses of the psychology of education has been this kind of paradigmatic work and all the participants have been content with it. The science of education has been a practical tool in administration at the local level and attention has been on practical problems in real situations. Thinking with psychological concepts is thinking with the problems of students (learning, motivation, ability, achievement, tests etc.). It is at the same time empirical-analytical as well as democratic towards the process of education.

The other side of the coin, many American colleagues claim, is that the practical approach has neglected the importance of content in the curriculum and instruction. Naturally, psychology of education as a background discipline leads thoughts to the psychological content and particularly to management and learning problems. These are no doubt an important part of the totality but not sufficient in themselves. Finding the content has led to looking at the European *Didaktik* again but this time from a special point of view, *Fachdidaktik*. I dare to point out, however, that the psychological problems have not vanished from the instructional process and that's why the general aspect of *Didaktik* should be kept in mind constantly.

Peter Menck (1993) has referred to the early German tradition of empirical educational research that existed alongside the old tradition of *Didaktik*. As we know, Wilhelm August Lay and particularly Ernst Meumann (1862–1915) are its main representatives. Meumann had been a student of Wilhelm Wundt but his interest had turned to the problems of *Didaktik*. Their experimental *Didaktik* could not gain status and it got only a marginal position in the area of German *Didaktik*. Heinz-Elmar Tenorth (1988, 214–219) calls it "der szientifische Flügel" – the scientific wing of reform pedagogy. Although its influence seemed to be small it had some very important disciples who were to continue the approach in a way that was discovered only after many years. Aloys Fischer (1882–1937) was the first and he turned the research from experimental to descriptive and Peter Petersen (1884–1952), a disciple of Meumann, was the other one who is generally considered the founder of the so-called *Pädagogische Tatsachenforschung*, empirical research on pedagogical facts.

Fischer developed his ideas in a phenomenological sense but independently from Husserl (Tenorth 1988, 217). The basic idea in this descriptive empirical research was to look at the instructional process as a phenomenon that is as much as possible theory-free. That requires observing the process as it is, without any predetermined theoretical assumptions. Petersen developed a sort of observation system in his Jena-Plan-School. The most important and central concepts were the pedagogical situation and the various aspects, pedagogical facts, that describe the pedagogical situation.

The descriptive line of *Didaktik* did not succeed in gaining a respected academic position and it remained a side trend lagging behind the erudition-centered *Didaktik*. The latest well-known work is that of Friedrich Winnefeld (1957).[1]

This line of development of the descriptive *Didaktik* is the German alternative to the empirical *Didaktik*. The literature is almost unanimous in stating that educational psychology in Germany has

been an independent discipline without any close relations with *Didaktik* and that the empirical influences have in general come from the US and from its psychology of education. In *Berliner Didaktik* the empirical approach is to be seen but gradually that part diminished with the work of Schulz. The contacts between German *Didaktik* and American research on teaching have been quite few.

As a conclusion it can be said that the erudition-centered *Didaktik* did not gain a footing in the US in the beginning of this century. Instead, the reflection on teaching continued in the psychology of education. In Germany reform pedagogy transformed into erudition-centered *Didaktik* which later found some rival directions. The empirical-analytical approach did not succeed in making a breakthrough in Germany in spite of a good beginning with Meumann and Lay. It lived for some time as descriptive *Didaktik* but it did not develop into psychology of education. The latter received its impulses from the US and has been a separate area alongside *Didaktik*.

The work of Peter Petersen is, however, very interesting from the viewpoint of German-American relations. Herman Röhrs (1993, 11–19) takes Petersen as an example from this interaction, as he analyses progressive education in the USA and its influence on European reform pedagogy. On the practical level the discussion about progressive education was international and the well-known systems of school reforms of Helen Parkhurst, Carleton Washburn, Maria Montessori, and Peter Petersen were influenced by each other. The "New Education Fellowship" was a connecting link between educational practical workers and researchers. In 1928 Petersen made a visit to the USA and became familiar with the American situation. This was later seen in his Jena-Plan. In spite of these kinds of relations between individual colleagues, the main trends in the area of *Didaktik* grew apart. Naturally, the political situation in the world contributed, but there were some ideological reasons, too.

Some contemporary trends

The role and the meaning of knowledge in educational research in recent years have clearly increased. Some interesting viewpoints have been brought into the terminology and communication. Shulman (1986b) has focused on teachers' understanding of the subject they are teaching. In addition to content knowledge, the essential substance is pedagogical content knowledge. This same aspect has been referred to by different names, and Reynolds (1992, 5) introduces various alternatives which all have something special: content-specific pedagogy, subject-specific pedagogical knowledge, content-specific cognitional knowledge, and subject matter-specific pedagogical knowledge. (cf. also Gudmundsdottir and Shulman 1987, 54–55.)

This old idea of pedagogical reduction of factual content for the purposes of teaching is known in the traditional German *Didaktik* as *Fachdidaktik*. The modern view of *Fachdidaktik* takes into consideration all the factors in the teaching-learning process from the content point of view. It was Ch. Helwig who as early as 1619 made a distinction between the common aspects of teaching (*didactica generalis*) and the content aspects of teaching (*didactica specialis*) (Knecht-von Martial 1985, 17–28). The idea, however, in spite of the use of different language, has always been known to parents and teachers. In any case, this comparison between pedagogical content knowledge and *Fachdidaktik* could offer useful knowledge to both sides.

The renaissance of content has aroused the idea of comparing the erudition-centered *Didaktik* with the new conception of research on teaching. Stephan Hopmann (1992) as well as Gudmundsdottir and Grankvist (1992) have already made a start in this respect. The latter also say that the new trend had nothing to do with the European *Fachdidaktik* (1992, 185). Although the idea looks the same there are essential differences.

Looking at Shulman's content knowledge and pedagogical content knowledge it is clear that the focus is on the substance that is the content in the instructional process. The introduction of these concepts has brought about lively discussion in the journals. When looking at this discussion more precisely, it is noticeable that the focus is not exactly on the substance or subject matter but on the structural analysis of this substance. What is presented is a reflection on what kind of elements there may be in the specific content. Frank Achtenhagen (1992, 316) remarks e.g. that "... the distinctions are useful: knowledge is regarded as the "subjective" aspect of subject matter and content as "objective"." My suggestion**,** however**,** is that the presentation of content is as formal and general as the former focus on students' properties: learning, motivation, achievement, etc. In other words, psychology of education still has a strict hold but from a different point of view from before and the possible paradigm shift is only a change in the themes and topics.

The change is, however, to be seen in the area of curriculum planning and in emphasising the importance of the instructional content in the curriculum. This is to do with cognitivism and action research along with the growing power of the teachers themselves in preparing their own curriculum. But if we compare the pedagogical content knowledge with *Fachdidaktik* on this level we soon notice that there are different kinds of assumptions behind them.

There are, however, only slight principal differences between pedagogical content knowledge and *Fachdidaktik* or between content knowledge and *Fachwissen* if we compare the German models of *Didaktik* with the American way of thinking and leave the erudition-centered *Didaktik* out of this comparison.

Heimann, Otto and Schulz had, in principle, in their *Berliner Didaktik* a very similar conception of the position of content in the curricular or in the instructional process to Shulman. Because their starting point was empirical-analytical there was no exact standpoint according to the substance but only a named category. Content was one central category in the totality of their model and the criteria of selection were brought from developmental psychology and the life situation of the pupils but no direct stand was taken on the selection of subject-matter. Later with the changes produced by Schulz, the model got much of the same characteristics as erudition-centered *Didaktik*. With these changes the position of content changed as well.

Critical-communicative *Didaktik*, however, has a clearly normative overstructure where content is selected with certain value criteria. The same features are found in critical pedagogy in the US but content in this model is not reflected from the viewpoint of structural analysis. The background is openly normative and political, and this is to be seen also in the instructional process itself. Group work and co-operation are the slogans, but the nature of pedagogical content knowledge is general and does not focus on school subjects as much as on the methods.

The curriculum movement brought its own conception of content with educational aims, goals, and objectives. It was structure again that was the guiding principle. Taxonomies stimulated very precise analyses of the psychological content. They also offered a good basis for the presentation of subject matter, but this movement had weaknesses in other respects and that's why it was not possible to build a curricular totality with this idea. The same can be said of cybernetic *Didaktik*, although the level of exactness required was extremely high. Content was given in the curriculum and the method algorithm was based on the conditions of the factors given in the curriculum.

In all these examples the common aspect is the interpretation of content as formal and general that can be further refined in the curriculum and in the teacher's work. This is very understandable because the models are built for all possible situations, subject matter and curricula. The selection

of content is left to practitioners, textbook writers and curriculum makers. The researchers have stayed out of this process because the concept of doing research has not included taking a stand on value questions and schooling policy. Changing the theme to the content of the teacher's thinking or to the cognitive structure of the teacher's thinking does not change the basic assumptions of the research; it remains within the same paradigm. Naturally we get other types of research results and our attention is focused on other kinds of problems, but the philosophy of doing research stays on the same foundation.

Gradually I am coming to my point of how to compare the German *Fachdidaktik* with the American way of thinking about the same problems. The comparison cannot be made by putting content or the analysis of the structure of this content or the typical characteristics of this content side by side. This is only superficial. The various curricula or textbooks can be compared in this way, of course, but if the motive is to compare the whole frame of reference, this is not enough. In the German *Didaktik* the key is German idealism with such names as Immanuel Kant, Friedrich Schleiermacher and Wilhelm Dilthey with many more recent names. We know this as *Geisteswissenschaften* and I have used erudition-centered *Didaktik* as its English equivalent in the area of teaching. The whole comparison can be simplified by putting erudition-centered *Didaktik* on one side and all other models on the other.

One more point must be taken into consideration and it is the purpose for building the *Didaktik* models and the models for research on teaching as well as the conception of curriculum planning. It has already been said that the German *Didaktik* models are built for teacher education and for instructional planning. The various models have a different approach to the selection of content and especially to the normative criteria of this selection. Only the erudition-centered *Didaktik* has a clear stand on this question and that is why it has a close connection with *Fachdidaktik* or pedagogical content knowledge. Research models are general and take no position on value questions, and that is why content is important in research design.
In the erudition-centered *Didaktik* the main task is seen to be to develop a theory of educational content (Theorie der Bildungsinhalte). The content of education is selected according to its value in the curriculum and in the instructional process. The decision is always based on tradition and history. It is also dependent on the particular group of students for whom the curriculum is written. As can be seen, the erudition-centered *Didaktik* has its main role in the planning and writing of the curriculum where the decision-making is openly value laden. The selection of content that is at the same time the selection of aims and goals is, however, not pure policy making because the erudition-centered *Didaktik* claims to have educational autonomy and expert knowledge in educational matters. In this system there are both formal educational criteria and clear normative decisions.

Another side of this question is that the same decision-making continues inside the curriculum when teachers select the instructional content, or the textbook writers decide on what is valuable to be transformed from content knowledge to pedagogical content knowledge. This second part is similar to teachers' work in general and in this phase the problem of learning comes to the fore. Erudition-centered *Didaktik* has been criticised for its neglect of learning and method problems in the instructional process. It has been more interested in what is valuable in content and what is worth teaching than controlling how much has been learned. In this respect there has been development in recent years.

The Nordic alternative

Didaktik in the Nordic countries has been educational psychology with an emphasis on the teacher and on the instructional process. The German *geisteswissenschaftliche Didaktik* has been practically

unknown with certain, mainly Danish and Norwegian, exceptions (e.g. Reidar Myhre, Torstein Harbo and Bjorg Gundem). When the educational psychology line and the *geisteswissenschaftliche* line are in contact with each other there are almost always conflicts to be seen. Yet the focus of both approaches is the instructional process, teaching and the teacher, and the curriculum etc. Why is it so?

You can easily note this conflict if some researcher is asked to evaluate the works of the other trend. The representative of the empirical research quite often says that it is not research at all, it is a number of opinions. The hermeneutic says that empirical research is only making notes about something which already exists in practice, but what then. Quite often they speak of technology, meaning thinking without creativity or alternatives.

A very good example of this situation is Wolfgang Brezinka who is said to represent critical rationalism along with Karl Popper's ideas. He divides education into three parts: philosophy of education, education and the practice of education. The first, philosophy of education, is not scientific at all. It is policy making, decision making, opinions etc. Naturally you must have some basis for your opinions but that does not change the essence of it. The practice of education is action and has nothing to do with science or *Wissenschaft*. You can use facts behind your practice but the action itself is not scientific by nature. Only the description, understanding, and explanation of the educational process are scientific.

Consequently, the difference is not in the focus, in the instructional process itself; it is behind the process in its theoretical assumptions. And as it is not possible to combine them, the conflict remains.

In the Nordic countries, with the above mentioned exceptions, the instructional process has been investigated along the empirical paradigm. That is why it is very difficult to make a difference between *Didaktik* and educational psychology. In practice these two subdisciplines have been a combined area with certain emphases partly on one, partly on the other. If someone has claimed the name of *Didaktik* in his/her writings, it has not been the *geisteswissenschaftliche Didaktik*. A good example of this has been the *Didaktik* discussion in Sweden.

In general, we note two perspectives in this discussion. The first line of research concentrates on the macro level, on the societal, economic and political prerequisites of education (Dahllöf, Lundgren, Englund). We cannot say that it does not take the very process into consideration, because Dahllöf and Lundgren have done this kind of research, too. Its emphasis and interpretation of the empirical results has, however, been on the macro level, on the frameworks. Curriculum research is a natural part of this line.

The other line of research concentrates on the other end of the educational process, on the learning of individual students or on their conceptions of this learning (Marton, Svensson, Lybeck, Kroksmark). There is much research in this group on the instructional process itself but, nevertheless, the focus is on a certain part of it. So one could say that both of them have a very important part of the instructional process as their focus but neither of them can be said to concentrate on the totality of the instructional process. And that is the very essence of the general *Didaktik*. At the same time this topic is enormously large and that is why most of the research is done in some sub-area. Accordingly, the totality of *Didaktik* is divided into subdisciplines and naturally research made in these areas is *didactcial* research, too.

It is not exceptional to have various schools of thought within *Didaktik*. As a matter of fact, it is more a rule to have different approaches to *Didaktik*. There is, however, a big difference in views of

the bases on which they are considered different. In the German *Didaktik* it is the decision of the philosophical background which determines the different perspective. In the Nordic countries, I think, the differences are not seen through these kinds of lenses although the philosophical base may be different. The various approaches live inside the empirical tradition although there may be a strong emphasis on e.g. phenomenology. Naturally this leads to the comparison of *Geisteswissenschaften* and phenomenology which is not an easy task. In any case the starting point has been within the empirical tradition and the various emphases have emerged gradually alongside the research work.

A Concluding Remark

The erudition-centered *Didaktik* is a very good example of how education is national in a broader international context. The question, however, remains whether it is possible to compare educational systems in different cultures and to transform new ideas from another culture if there is not enough critical appraisal.

Note

Of special interest is that Toivo Laurilehto wrote a dissertation in 1980 “Sykliketjut opetuksessa” (Verbal compound cycles in the classroom teaching situation) following the method of Winnefeld.

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Seeking connections between different perspectives on teacher education: in support of a science of the Teaching Profession

Abstract

This paper seeks to address specifically the relation between educational psychology and didactics and the role of didactics in teacher education. With regard to the latter it seeks to explore the role of "Fachdidaktik" (Subject Didactics) in teacher education with specific reference to mathematics education from a UK (England) perspective. The emphasis on the social and cultural aspects of education that is apparent in "Didaktik" mirrors current debates in mathematics education that are discussed in the paper. Close parallels are seen to exist between "Didaktik" and Vygotskian cultural psychology and the related fields of activity theory and social practice theory. These perspectives are outlined and the parallels with "Didaktik" are discussed. Subsequently some reflections are offered on the potential nature of "Fachdidaktik" as it might relate to mathematics education. Finally reflections are offered on recent developments in England and Wales in response to some of the issues raised in the paper.

Introduction

In seeking to address the relation between educational psychology and Didaktik (didactics) it seems necessary to attempt firstly to clarify terms as far as possible. As Kansanen (1995) points out in relation to the term "Curriculum", this is "strongly culture-bound which is why comparison of meaning across linguistic boundaries is fraught with a variety of difficulties". The same difficulties apply to the term "Didaktik". However beginning from the direction given by Seel (1999) that Didaktik "may be conceived as the science whose subject is the planned (institutionalised and organised) support for learning to acquire 'Bildung'", the need arises to address the meaning of Bildung and also to reflect on the term "science". Hopmann and Kuenzli (1992) are quoted in Kansanen (1995) as suggesting the term "erudition" as an appropriate translation of "Bildung". The Oxford Thesaurus (Urdang, 1991) offers a range of terms that include the following: culture, education, knowledge, learning, scholarship and wisdom. Similarly "erudite" has the following terms listed: academic, educated, intelligent, knowledgeable, learned, literary, philosophical, scholarly and wise. In relation to the term "science" this is defined in the Collins Cobuild English Language Dictionary (Sinclair, 1987) as "the study of the nature and behaviour of natural things and the knowledge we obtain about them through observation and experiments". Psychology, sociology and anthropology are suggested as examples of a particular branch of science involving "the study of some aspect of human behaviour" i.e. a social science in contrast to a natural science. This leads to my interpretation of Didaktik as a social science whose subject is the planned support for learning to acquire "Bildung". In turn, my interpretation of "Bildung" is of a state of being which is characterised by a cluster of attributes which can be described by terms such as: academic, educated, intelligent, knowledgeable, learned, literary, philosophical, scholarly and wise.

An immediate observation is of the emphasis that is placed on the social and cultural aspects of education by adopting such a starting point. This emphasis is best summarised with reference to the "anthropological basics and foundations in educational sciences ('Erziehungswissenschaften')":

Human beings are born into a culture, a cultural environment, including a social system. Human personality is developing and shaping in a lifelong process. This development encompasses physical learning processes in interaction (maturation and decline) as well as psychical learning processes in interaction with other human beings and in dealing with cultural phenomena such as objects, institutions, ideas, sciences etc. The acquisition of and the dealing with cultural objects may be conceived as a major part of "Bildung" as a process, which represents a cluster of learning processes. (Seel, 1999)

This emphasis on the social and cultural aspects mirrors current debates in mathematics education and is the focus of discussion in the following section of this paper. A second and related observation is of the close parallels between "Didaktik" and the cultural psychology of Vygotsky (1962) and related fields of activity theory e.g. (Mellin-Olsen, 1987) and social practice theory e.g. (Lave and Wenger, 1991). These parallels are considered in a subsequent section of the paper.

Current debates in mathematics education – the tension between social and individualistic perspectives

In tracing the development of educational research traditions Kansanen (1995, p.106) highlights the way in which the American and German traditions diverged from around the end of the 19th century. He points out that the psychology of education "took its (Didaktik's) place as a discipline of the science of education in the US" and that psychology of education "still has a strict hold" (p.110) on contemporary thinking about teaching and learning in the US. I would argue that this has been the case also in the UK. Evidence of this phenomenon can be seen through the way in which the International Group for the Psychology of Mathematics Education (PME) has become synonymous with being the major international forum for research in mathematics education. A further dimension to this phenomenon in the UK that has been written about by, amongst others, Jones and Mercer (1993) is the extent to which related theories of learning have been dominated by individualistic perspectives i.e. behaviourism and constructivism in the tradition of Piaget. Constructivism itself has taken on a variety of meanings with "radical constructivism" (von Glaserfeld, 1987) becoming a very significant influence in mathematics education during the 1980s in particular. More recently there has been an emphasis on the notion of "social constructivism" although Lerman (1996) argues that this position is incoherent. He highlights the way in which the programs of Vygotsky and Piaget had "fundamentally different orientations" with a Vygotskian perspective placing the social life as primary and a Piagetian view placing the individual as primary. The major difficulty for radical constructivism is seen to be in offering an adequate explanation of intersubjectivity. He quotes Cobb, Wood and Yackel (1991) as stating the problem clearly. They argue that constructivism "at least as it has applied to mathematics education, has focused almost exclusively on the processes by which individual students actively construct their own mathematical realities" and that "far less attention has been given to the interpersonal or social aspects of mathematics learning and teaching".

A rather stronger critique is that offered by Michael Apple (1995):
Most discussions of the content and organisation of curricula and teaching in areas such as mathematics have been strikingly internalistic. Or where they do turn to 'external' sources other than the discipline of mathematics itself they travel but a short distance – to psychology ... though it has brought some gains ... it has profoundly evacuated critical social, political and economic

considerations ... In the process of individualising its view of students, it has lost any serious sense of social structures and the race, gender and class relations that form those individuals.

Cultural psychology, activity theory and social practice theory

There are a number of basic assumptions underpinning the cultural psychology of Vygotsky. A primary assumption is that socio-cultural factors are seen as essential in human development. As individuals we are seen to be constituted by our social, historical and cultural experience. The social context is not seen as causative (e.g. of disequilibrium, accommodation etc in Piagetian terms) but rather as constitutive. Intellectual development is seen in terms of: meaning making, memory, attention, thinking, perception and consciousness that evolves from the interpersonal to the intrapersonal. The process of development itself is conceived of as "a complex, dialectical process characterised by a multifaceted, periodic timetable ... by complex mixing of external and internal factors, and by the process of adaptation and surmounting of difficulties" (Vygotsky, 1981).

The social dimension is seen to be primary in both time and fact and the individual dimension is derivative and secondary. Writing from such a perspective, Lerman (1996) highlights the way that language provides the tools for thought, and carries the cultural inheritance of the communities (ethnic, gender, class, etc) in which the individual grows up. Consequently language is not seen as giving structure to the already conscious cognising mind but, on the contrary, the mind is seen to be constituted in discursive practices. He offers the following quotation from Kozulin:

It is incorrect to consider language as correlative of thought; language is a correlative of consciousness. The mode of language correlative to consciousness is meanings. The work of consciousness with meanings leads to the generation of sense, and in the process consciousness acquires a sensible (meaningful) structure. To study human consciousness means to study this sensible structure, and verbal meaning is the methodological unit of this study. Such a study can be carried out at the abstractive as well as the concrete level. At the level of abstract psychology we can study general rules of signification; at the concrete level we should be concerned with the specific "sense generating" activity that changes the consciousness of a person.
(Kozulin, 1990, p.190)

Vygotsky highlighted the dialectical nature of thought and language by proposing that these have separate roots. Speech is seen to evolve out of gestures developed within the context of communication and social interaction whilst thought (especially logical thought) evolves from the child's activity. It is further proposed that speech can be considered to have two particular forms – egocentric and communicative respectively. The function of communicative speech, as implied in its description, is for the purpose of communication with others. On the other hand, the function of egocentric speech is as an instrument of thought itself i.e. a psychological tool. This leads to Vygotsky's notion of *internalisation*, by which the means of social interaction, especially speech, are taken over by the learner and internalised. Development proceeds when interpsychological regulation is transformed into intrapsychological regulation.
The mediational role of cultural and psychological tools reflects the emphasis of Marxist philosophy on the central role of labour in cultural development. This stresses the transformation of objects using tools in this process. The notion of the psychological tool was first introduced by Vygotsky as an analogy with the material tool e.g. a chisel, which serves as a mediator between the human hand and the object upon which the tool acts. For example the computer can be viewed as a cultural tool which is itself transformed into a psychological tool by means of social interaction. The idea of the mediational role of tools is extended to psychological tools such as sign and symbol systems e.g. language, writing, number systems (semiotics).

Activity theory has its roots in Vygotskian cultural psychology. Crawford (1996) highlights how activity denotes personal (or group) involvement, intent and commitment that is not reflected in the usual meanings of the word in English. She draws attention to the fact that Vygotsky wrote about activity in general terms to describe the personal and voluntary engagement of people in context – the ways in which they subjectively perceive their needs and the possibilities of a situation and choose actions to reach personally meaningful goals. In building upon Vygotsky's work, Leont'ev, Davydov and others made clear distinctions between conscious actions and relatively unconscious and automated operations. Operations are seen as habits and automated procedures that are carried without conscious intellectual effort. So that *activity* corresponds to a motive, *action* corresponds to a goal and *operation* depends upon the conditions. Mellin-Olsen (1987) highlights the dialectical nature of activity theory and also acknowledges the need to recognise that learning does not take place solely in the context of the classroom:

We shall also study learning outside it, and we shall see how inside-classroom activities relate to outside activities. The dialectics here is located in the part-whole relationship: the classroom activities within learning activities as a totality which includes classroom learning.

Also consistent with this perspective are the insights offered by Lave and Wenger's (1991) social practice theory further illustrated in Lave (1988 and 1996). This work offers a view of learning as an aspect of participation in communities of practice, which is at first 'legitimately peripheral' in relation to any new practice but that increases gradually in engagement and complexity. Learning is located in the processes of co-participation, as opposed to within the heads of individuals. The learner acquires the skill to perform by actually engaging in the process, under the conditions of *legitimate peripheral participation* (LPP), to a limited degree and with limited responsibility. Those participating in the community are seen as learners and learning, as such, is distributed among co-participants and is not seen as a one-person act. With regard to understanding, this is not seen to arise out of the mental operations of a subject on objective structures, rather it is located in the increased access of learners to participating roles in expert performances. Learning can be a feature of various practices and is not seen to be limited to examples of training and apprenticeship. For example, the production of language can be seen as a social and cultural practice. Lave and Wenger's notion of LPP can be seen as a way of engaging and as an interactive process in which the apprentice engages by simultaneously performing in several roles. Learning is seen as a way of being in the social world rather than as simply a way of coming to know about it. Learners are actively engaged not only in the learning contexts but also in the broader social world and learning presupposes engagement without which no learning will occur i.e. *activity* corresponding to a motive as being an underpinning requirement for such a view of learning.

Lerman (1997) argues for the relevance of such a theoretical perspective, and of activity theory in particular, to the development of teachers themselves in (mathematics) teacher education. He outlines three important factors in support of this view. The first is that it offers a 'coherent single framework for learning throughout life' that applies from childhood through to adulthood. Secondly 'it attempts to integrate affect and cognition in focusing on meaning as its unit of analysis' and thirdly 'it offers a method of rooting knowledge and action in socio-cultural-historical settings'.

Parallels between Didaktik and cultural psychology, activity theory and social practice theory

In this section I will seek to identify 'connections and parallels' between the various perspectives outlined in the previous section and the issues raised in the discussion paper (Seel 1999, chapter 1 of this publication). The immediate observation of the emphasis that is placed on the social and

cultural aspects of education with reference to the "anthropological basics and foundations in educational sciences ('Erziehungswissenschaften')" has already been discussed in the introduction. However this is re-emphasised as being a key similarity and stands in sharp contrast to the individualistic psychology that has dominated thinking about teaching and learning in the US and UK for so long.

Seel argues that "those processes of learning, which in their entirety represent the process of "Bildung", receive their impetus by dealing with people and experiences with objects". The parallel here is with the Vygotskian emphasis on social interaction and the mediational role of tools. That they "occur occasionally and may be seen to be accidental and disordered" reflects the Vygotskian view of development as "a complex, dialectical process characterised by a multifaceted, periodic timetable ... by complex mixing of external and internal factors, and by the process of adaptation and surmounting of difficulties" (Vygotsky, 1981). The emphasis on the overarching goal of helping young people to become "more responsible and competent members in the sense of educated personalities ('Gebildete')" reflects the emphasis placed by social practice theory on learning as an aspect of participation in communities of practice under the conditions of *legitimate peripheral participation* (LPP). This idea is elaborated further in the discussion paper with reference to an "intermediate actual state in the process of personal development" i.e. the "status of being in a culture" with the overall aim of becoming "an able member of an esteemed society" or expert.

The idea that "spontaneous and situational learning has to receive support and supplement by planned intentional teaching" reflects two further aspects of Vygotskian thinking. Firstly there is the notion of learning based upon the acquisition of "scientific" and "spontaneous" concepts. Scientific or systematic concepts are seen to be those abstract concepts that are part of the culture e.g. of mathematics, science etc. In contrast spontaneous concepts are seen as being more "concrete", based on face to face meetings with a "concrete" situation. The development of the learner's spontaneous concepts proceeds upwards and the development of the scientific concepts downward, supplying the structures for upward development. This also reflects the emphasis of Mellin-Olsen (1987) on the dialectic between "inside-classroom activities" and outside activities. Secondly is the notion of the "zone of proximal development" (ZPD) – the distance between the actual developmental level as determined by independent problem solving and the level of potential problem solving under adult guidance or in collaboration with more capable peers. These ideas are elaborated further in the discussion paper under the headings of "natural" (spontaneous) and "institutional" (scientific) learning.
The emphasis on the "selection and provision of cultural components as goals and content of learning" reflects the central notion of goals in activity theory and social practice theory. This idea is developed further in stating the overall aim of "Didaktik" as being the "educated personality" ("Gebildete/r") which is specified as:

(i) in an egalitarian sense it has to apply to all citizens
(ii) as regards content, it relates to central problems of living and
(iii) surviving relevant to everybody and these may be called 'key problems'
(iv) as regards the human potential it relates to all human capabilities

(Seel, 1999)

In reflecting on the overall aim of "Didaktik", there are parallels with the idea of activity (in its strong sense) through the way in which it provides purpose in the "supporting of learning to acquire 'Bildung'".

Within "Didaktik" a theory of syllabus ('Lehrplantheorie') is identified and specifically distinguished from the notion of "curriculum" in the discussion paper. This is seen to concern the following two questions:

(i) Legitimisation and structuring of learning areas
(ii) Selection and definition of learning goals and learning subjects.

With regard to teaching two aspects are identified:

(i) How has the process of teaching to be structured so that students find optimal conditions for their learning?

With respect to this question it is suggested that it is necessary to find structures of teaching based on and compatible with structures of active learning. Reference is made to gestalt psychology though there are also clear parallels with the notion of "scaffolding" as outlined by Bruner (1985) based upon Vygotsky's work. The second question is:

(ii) How have the learning situations in the social context of a classroom to be arranged, so that students find ample opportunity for individual and active learning?

With regard to this question, it is suggested that "a balanced relationship between autonomy of the learner and external guidance by the teacher has to be found". This aspect is resonant with the role of the teacher within Vygotsky's zone of proximal development. A further parallel to the ZPD can be found in the statement that:

Teachers who arrange learning situations following a problem-oriented approach seem to fulfil the pedagogical goal of reducing the difference of competence between teacher and student and therefore helping the student to emancipate.

"Fachdidaktik" (Subject Didactics)

The distinction made in the discussion paper between "Allgemeine Didaktik" (General Didactics) and "Fachdidaktik" (Subject Didactics) mirrors the distinction in England and Wales of Professional Studies and Subject Studies. The proposal is that "Fachdidaktik" should be concerned with:

1. Matters relating to the teaching content of subject teaching.
2. Matters relating to subject specific teaching processes.

Within the first category it is suggested that the educational purposes of the subject should be included together with the science-subject relationship, syllabus of the subject, subject matters and content and learning objectives. These seem relatively uncontroversial apart from the science-subject relationship that is likely to be open to a variety of interpretations. With regard to the second category this includes teaching structure and process, teaching methodology, media and evaluation. This area is one which is rich in potential for further discussion and sharing of perspectives and issues which are likely to be subject to wide cultural differences.

As one example, the call for a science of education in the field of mathematics education is not a novel idea. Gattegno (1987) first published his work in the form of a book entitled *The Science of Education, part 1: theoretical considerations*. In writing on this theme Tahta (1988) comments that "Gattegno's proposal is that shared awareness is an appropriate basis for a science". Gattegno

suggests the need to enlarge our notion of science to cover the "know-hows" associated with growing food or making tools, "so that we can grant that our ancestors were also "scientists'". There are parallels with social practice theory in such a perspective. Gattegno argues that all sciences begin with a new awareness – "of light, or sound, or, in the case of mathematics, of relations as such". Tahta proceeds to argue that the science of education" is concerned with the awareness of awareness itself":

… with listening and not with sounds, with touching and not with what is being touched,. With tasting and not with the cause of the taste, with smelling and not with the atoms which reach one's nose.

(Gattegno, 1987)

He proceeds to direct your attention as the reader of the text by asking you to let yourself become conscious of your reading, as you read these words. "Do your eyes flicker? Do you take in chunks at a time? What images do you invoke? Are you with the reading? Are you now with the self that was with the reading?" He quotes Gattegno who argues that when "watchfulness" becomes second nature and one is able to adjust immediately to the "subtle demands of consciousness" then it is possible to say that one is a scientist in the science of education.

So, argues Tahta, "the science of education uses aspects of *watchfulness* as its tools and a process of *continuous feedback* as its verification". This is resonant with Imsen's (1999) idea of the 'learning circle' which is itself consistent with the action research cycle of planning, action, observation and reflection which has been used widely and effectively by practitioners in the UK. An important role for the teacher according to Gattegno is in "forcing awareness". This has echoes of the role of the teacher in Vygotsky's ZPD. It is addressed explicitly by Tahta who quotes Simon (1985) as claiming that "the ideals of universal education are floundering for the lack of a pedagogy that emphasises what children have in common as opposed to their individual uniqueness." This is interpreted as a call for "a science of education" and he proceeds as follows:

There seem to be two competing choices. Either we continue to enquire what children can do as individuals and then create 'learning environments' in which they can create their own mathematics, and so on. Or – and this may be unpalatable to some readers – we try to find out what it is that all children have done and can do, and then teach them – in groups – in a more directed and sustained way.

(Tahta, 1988)

Tahta also discusses "ways of knowing" and gives the example of "intuition" which is illustrated in relation to the use of geoboards, cuisenaire rods and mathematical films. He argues that intuition "demands the whole of one's self" and that this is what is required when one meets and tries "to maintain complexity". He argues that it operates in "precisely the opposite way to the 'focusing' traditionally stressed in Western thought and education".

Discussion

Two of the major issues raised by this discussion are the tensions between individualistic and social perspectives and those between fragmentation and integration (holism). The issues around the former have been the subject of much consideration in this paper and those related to the latter have been touched upon. In tracing the historical development of the separation of the German and American traditions, Kansanen (1995) cites Doyle and Westbury (1992) as the source of the quote, attributed to Ellen Lagemann, that "one cannot understand the history of education in the United States during

the 20th century unless one realises that Edward L. Thorndike won and John Dewey lost". He proceeds to observe that this way of thinking "was too fragmented and its behavioural and experimental features were too narrow to apply to the whole process of education". Vygotsky (1962, 178–179) has some pertinent observations to make on such a perspective in a discussion concerning the issue of the role of formal discipline in the tradition of Herbart. He explains the idea as maintaining that "instruction in certain subjects develops the mental faculties in general, besides importing knowledge of the subject and special skills." He argues that this is a "genuinely sound idea" but that it led to the "most reactionary forms of schooling, such as the Russian and German 'classical gymasiums'" which stressed Latin and Greek as sources of "formal discipline". He proceeds to argue that Thorndike "did his best to discredit formal discipline and to prove that instruction had no long term effects on development". He develops his argument by observing that Thorndike's criticism is convincing in relation to the "ridiculous exaggerations of the doctrine of formal discipline" but that it does not "touch its valuable kernel".

On Thorndike's methodology, Vygotsky observes that this involved "experimentation with the narrowest, most specialised, and most elementary functions". He argues that "from the point of view that of a theory that reduces all learning to the formation of associative bonds, the choice of activity would make little difference". The following summarises the critique that Vygotsky makes:

Thorndike's work merely makes it appear likely that there are two kinds of instruction: the narrow specialised training in some skill, such as typing, involving habit formation and exercise and more often found in trade schools for adults; and the kind of instruction given schoolchildren, which activates large areas of consciousness. The idea of formal discipline may have little to do with the first kind, but may well prove to be valid for the second. It stands to reason that in the higher processes emerging during cultural development of the child, formal discipline must play a role that it does not play in the more elementary processes: All higher mental functions have in common awareness, abstraction and control. In line with Thorndike's theoretical conceptions, the qualitative differences between the lower and higher mental functions are ignored in his studies on the transfer of training. (Vygotsky, 1962)

In considering developments in England and Wales over recent years, it is clear that this has been a period of increasing fragmentation, initially through the introduction of an over-prescribed National school syllabus (mistakenly described as a Curriculum) which from the outset has been in a process of unravelling. Recently these principles have been applied in similar fashion to teacher education itself in a way which suggests that lessons have not been learned from past mistakes. Combined with this development has been the establishment of elaborate systems of inspection, monitoring and evaluation in the name of accountability, improvement and effectiveness. The consequences of such developments, if they were to have any lasting impact on teachers and teaching, would be to reduce the role of the teacher to that of technician.

However it seems clear that one way towards effective reform of the system is by winning over the hearts and minds of the teaching profession as a whole. In recent years political leaders have not demonstrated even satisfactory levels of competence in this respect. Unfortunately the adversarial approach continues to be taken by leading figures in the relevant government agencies. In the case of the Teacher Training Agency the adversaries are the teacher educators in the universities whilst with the Office for Standards in Education, almost the entire teaching profession has come to feel vilified by Her Majesty's Chief Inspector (HMCI). In this respect it is forcibly argued by a predecessor (Pyke, 1998) that the role of HMCI is now 'out of control', having accused the current post holder of using unprovable statistics and polemic. It is unfortunately the case that this is a view that is

likely to attract wide support throughout the teaching profession in England and Wales, which in itself may prove to be a major obstacle to constructive engagement and future development of the profession as a whole.

Given such a context it is particularly interesting that the Teacher Training Agency has come to appropriate the term "pedagogy". However this has happened without any underpinning theoretical basis having been elaborated and is illustrative of an atheoretical approach which does not see the need for an academic aspect to the preparation of teachers. The Chief Executive of the TTA is reported as seeing pedagogy as 'the science, the art, the craft of teaching – as central to the issue of learning effectiveness and, therefore, a prerequisite for school improvement' (Levis, 1998). However as Bassey (1998) points out what is ignored, or even unrecognised, is the range of ideological positions that underpin the practice of teaching. He argues that 'policy and practice vary according to whether there is a belief that the most important role of the teacher is to transmit subject knowledge or to foster the moral, social, creative and intellectual growth of pupils and students'. Similarly one may hold to the reductionist view of learning, as elaborated long ago by Thorndike, or ascribe to Vygotsky's recognition of learning as being concerned with the development of 'higher mental functions'.

In reflecting on these developments it is pertinent to consider what, if any, lessons might be learned to guide future developments. As indicated earlier, the signs from the TTA and OFSTED are not hopeful in terms of building trust with the teaching profession at this time. Unfortunately the adversarial and chastising approach has also been adopted by some government ministers, thus limiting, and possibly even curtailing, chances for constructive engagement with the teaching profession. However there are more hopeful signs emerging from the Qualifications and Curriculum Authority (QCA). In discussing the aims of the national curriculum review for schools, the Chief Executive of the QCA writes that:

In taking forward this agenda, QCA will involve teachers and other partners in the education service. One lesson we learned from the first version of the current curriculum is that unless there is shared understanding of why changes are being made, and a commitment to them, they are unlikely to succeed. The forthcoming revision is a much more limited exercise, but the principle still applies. The exercise will proceed collaboratively, with full consultation, and on the basis of firm evidence that it works.

(Tate, 1998)

A particularly encouraging sign is the recognition by the QCA that the National Curriculum for England and Wales is distinctive for its lack of 'a clear and explicit rationale' and associated set of aims. The lack of a shared sense of purpose is acknowledged and stands in sharp contrast to the overall aim associated with Didaktik of 'Gebildite' or 'educated personality' comprising (i) 'in an egalitarian sense it has to apply to all citizens; (ii) as regards content, it relates to central problems of living; (iii) is relevant to everybody and may be called 'key problems' and (iv) as regards the human potential it relates to all human capabilities'

(Seel, 1999)

A second hopeful sign, despite the adversarial style, is the start of a debate about what constitutes pedagogy in England and Wales. In terms of moving the debate forward at this time I wish to propose a broad understanding of pedagogy, consistent with the 'continental' approach so applauded by the TTA Chief Executive. In particular, I would like to propose the following definition of pedagogy*:*

The term 'pedagogy' is broadly understood. It raises the question of the place and meaning of children and youth in the frame of human experience. It asks for the nature of home and school life and for the meaning of learning and curriculum experiences of those who inhabit educational institutions. It raises the question of what it means for one adult (teacher, parent, counsellor, administrator, psychologist, social worker, or friend) to be pedagogically present to another. And pedagogy raises the need for a critical examination of relevant professional practices, particular modes of reasoning, and of those institutional and societal arrangements which make an emancipatory praxis necessary.

(van Manen, 1983)

Associated with such a broad understanding of pedagogy is the need for an appropriate range of research methodologies. In particular the relevance of phenomenological approaches should be considered which are defined by van Manen as 'those forms of thinking or enquiry which in some way maintain a perspective on the lived human experience'. He outlines further the way in which such an attitude 'creatively seeks approaches which may yield a deeper understanding of the nature of pedagogy: the way we are to live with children or those, young or old, with whom we stand in a pedagogic relationship.'

With regard to "Didaktik", Kansanen (1995) suggests that if we emphasise the normative side of "Didaktik", the most appropriate description would be "the art of teaching". However he argues for a wider definition which includes a "reference to learning in its meaning". It is appropriate that consideration be given to the notion of the development of a science of education transcending that which emphasises the normative aspects of "Didaktik" and in doing so combines this aspect with a similar emphasis on learning. In relation to this it is relevant to note that in Russian there is only one word, "Obuchenie", for teaching/learning. This idea has a parallel with that of "Unterrichtfach" which Kansanen suggests is best translated as teaching-studying-learning. This implies a model of human development that is very different from an internalistic individualistic theory that has resulted from the dominance of this field by an individualistic psychology for so long. It also implies a re-conceptualisation of the teaching-learning process for many policy makers in the UK. It requires a move beyond the false dichotomy between teaching and learning and beyond the practice of 'thinking in boxes' when it comes to educational policy making. It also requires a recognition that the education process is concerned with the development of 'higher mental functions' and not narrowly conceived technical competences.

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Existing models of knowledge in teaching: developing an understanding of the Anglo/American, the French and the German scene

Abstract

This paper explores existing models of knowledge in teaching in three different environments: the Anglo/American; the French; and the German scene. Particular attention is given to models of mathematics teaching. In each scene it is attempted to develop an understanding of the different aspects of the models, to comprehend their underlying concepts, how they are constructed, and in some cases how they developed historically. By doing this, similarities and differences could be identified. It is concluded, firstly, that what is common to all models in all countries considered is that knowledge in teaching is not seen as static, but as a process of development and change and that experience in the classroom contributes to its growth and change. Secondly, there are differences in terms of origins of concepts, their background in terms of educational traditions. Thus, it is argued that models of knowledge in teaching have to be understood in terms of the countries' educational and cultural traditions in which they developed. This might usefully guide researchers to the development of a common understanding of what is generally called 'the science of teaching' or 'didactics', as well as to the identification of research and development projects in the areas of teachers' knowledge. In order to make the task manageable distinctive models were chosen for the Anglo/American scene, in particular that of Shulman in terms of teachers' knowledge in general, and that of Ernest in terms of mathematics teaching. For the French scene particular concepts were selected that originate in French research on didactics and mathematics didactics, and these were linked with corresponding didactical theories. For the German scene the research drew almost exclusively on literature that presented and compared the German concept of Didaktik with the Anglo/American concept of research into teaching and curriculum. Therefore, the reader can imagine a grid with three lines (Anglo/American; French and German) and two rows (general didactics; mathematics didactics) which need to be filled with theories and concepts. The main emphasis of the paper is on the Anglo/American aspectt, simply because in England the main literature is available in English and it is on the Anglo/American representation of teacher knowledge.

Introduction

In recent years questions relating to teacher knowledge have received an increasing amount of attention by researchers. Researchers have investigated the professional knowledge of teachers from different angles. It is accepted that what teachers know is one of the most important influences on what happens in classrooms and, in turn, on what students learn. Recent studies (for example, Pepin 1997) point out that changes in teaching practices, for example, can only be successful if the context (cultural and structural environment) in which teachers are working is taken into account.

The conceptual tools that teachers possess in order to deal with their work situation depend to a large extent on the cultural (and structural) traditions of the educational environment in which they are working. However, there is no consensus on what teachers need to know in order to ensure that student learning is taking place.

Whilst there does not exist a commonly agreed upon bounded knowledge base for teaching in secondary schools, the body of knowledge from which teachers, teacher educators and curriculum innovators can draw is substantial and growing. With this increasing research the understanding of what teaching consists of and what it requires has been broadened. Teaching is now seen as an ambiguous and complex task requiring the time and willingness to reflect upon and revise actions and decisions, requiring action and decision-making. Teacher judgements therefore are likely to be rooted in a deep understanding of teaching and learning, of the learners and of the subject matter, amongst other factors, and how these components interact in the teaching-learning process in the classroom.

Although it is widely accepted that teachers' knowledge is an integrated system with each part difficult to isolate, most research has not studied teacher knowledge as integrated. Concerning the interconnected nature of different areas of knowledge, Barnes (1989) asserts the following:

Talking about teaching is analogous to describing a tapestry that has many threads of different colours woven into complicated textures and patterns. One can remove individual threads and examine them separately, but one cannot appreciate the complexity of the tapestry without seeing how the threads are interwoven to create the whole cloth. As each domain of knowledge is discussed, therefore, one or more areas will also be mentioned. (p.13)

This reflects the view that areas of knowledge interact and presumes that any attempt to disentangle different areas of knowledge is likely to be both arbitrary and artificial.

As understanding of teaching and learning have grown, views of teaching and learning, of learners, and of subject matter have changed. Views of learning have changed from that of the 'passive' to that of the 'active' learner. This involves the aim that learners construct meaningful understandings as a result of engagement in activities within an instructional situation that takes into account the context, the learner's prior knowledge and his/her perceptions of goals for learning. In line with these concepts of learning, views of teaching have changed too, in the sense that researchers have recognised the interactive nature of teacher knowledge. This involves the recognition that teaching is not a linear process of transmitting knowledge from the teacher (or textbooks) to students. The work that dominated educational research on teaching at the beginning of the 19th century to the middle of this century was based on answering questions such as *how best to teach* and *what methods are best* in relation to different topics and subjects. In the third quarter of this century research on teaching changed to what teachers and their pupils observably did in classrooms (for example, Brophy and Good 1986). Since the 1970s emphasis has shifted from what teachers (and pupils) do to enquiries about teachers' thinking, about the knowledge they hold, how this is organised, and how different knowledge sources inform teaching (for example, Shulman 1987). Underpinning this view is the idea that teachers construct their own conceptions of the topics they teach and that they generate their own representations for their students to understand.

Studies of interactive teaching (for example, Clark and Peterson 1986), examinations of knowledge used by teachers in 'routine' situations (for example, Shavelson and Stern 1981), and studies of how experts and novices use knowledge differently (for example, Leinhardt 1989) support the perspective that teacher reasoning depends on the richness of their knowledge about their pupils,

the events and objects; and on the relationships teachers perceive between and among these things. They also suggest that experts organise their knowledge in meaningful clusters and that they connect these in a network of coherent relations. This organisational knowledge is believed to guide teachers' intentions, beliefs and practices (Shavelson and Stern 1981).

But not everyone agrees with this 'information-processing' model of thinking (Barnes 1989). For example, Halkes and Olson (1984, in Barnes 1989) assert that teacher thinking is too subtle and complex to be reduced to models based on this theory. In their view the information-processing theory (information from many sources organised by individuals into cognitive structures) is useful for explaining teacher thinking, but the ways the clusters interact is likely to be as important. Toulman (1972) proposes the metaphor of 'intellectual ecology'. He contends that, as in an ecosystem, patterns are constantly changing as the system evolves; in the same way in the classroom multiple 'interwoven structures' (rather than single static structures) operate to inform teacher judgement. Therefore, according to him, knowledge is organised into multiple interacting clusters of related concepts, and these change according to the teaching situation.

The emerging view of teaching as thought-in-action has repercussions for teacher education in the sense of how to transform knowledge into professional education. Typically teacher educators have provided student teachers with components of knowledge from all the domains of knowledge that can inform teaching. But deciding which knowledge and experience to include raises the question of which concepts of teaching and learning and of the nature of the subject itself underpin the selection of content.

In terms of conceptions of teaching and teaching expertise, Kennedy (1987 in Barnes 1989) outlines four ways that different professions have defined the expertise crucial to professional performance, because she believes that conceptions of the fundamental nature of the work influence formulations of the knowledge (and thus the expertise) that is expected of the expert in that profession. Firstly, she suggests 'technical skill' as an expertise, but argues that programmes based on skill training have been largely abandoned because training in performance skills is no longer seen as an adequate preparation for actual practice. Secondly, she draws the comparison with medical schools when outlining the 'application of theory to practice'. Kennedy (1987) and also Schön (1987 in Barnes 1989) argue that knowing a principle is insufficient preparation for teaching, because student teachers must firstly recognise a classroom event as one where the principle applies. Therefore the ability to identify events and distinguish among cases is the difficulty in this model. Thirdly, Kennedy refers to 'critical analysis', as in law schools where students learn how to analyse and critique cases that have already been tried. Whilst this model appears to be successful in developing students' analytical skill expertise, it does not teach them to improve the situation (once they have analysed it). Fourthly, as an alternative to these concepts of professional expertise, Kennedy (1987, in Barnes 1989) suggests that teaching can be viewed as 'deliberate action'. She argues that

the expertise needed by professionals is the capacity to make sense of a situation by comparing it to situations that one has previously encountered. Based on knowledge gained from reflection on and critical analysis of previous experiences, professionals can postulate alternative interpretations of a situation and ways to respond. They can then reflect and revise their initial understandings. (p.19)

Therefore, and contrary to the 'epistemology of technical rationality' in education (Smyth 1987 in Barnes 1989), theory is not separated from practice. Student teachers are encouraged to reflect upon and reformulate assumptions about the nature, purposes and conditions of their work as teachers. Teaching expertise is thus the capacity for principled thought about the details of the situation in the

classroom for example, that leads to action. It also includes the capacity and willingness to reflect on one's decisions and actions in the light of their potential impact on learning (Barnes 1989). The goal is to help teachers to develop for themselves meaningful frameworks for teaching. Featherstone (1987) mentions that 'knowledge does not mean anything until it is remade in the present'.

The Anglo/American scene

It is widely accepted that what teachers know is one of the most important influences on what is happening in the classroom in terms of teaching and learning. However, there is not one body of knowledge that has been identified as necessary to ensure that learning is taking place. Indeed, many components of teachers' professional knowledge have been identified.

This section will provide a review of influential perspectives in recent research that have dealt with the questions of teacher knowledge. In order to make the task manageable, first a general overview is given, then examples of well-conceived studies that address what are regarded as important research themes are identified, and these are presented together with a brief discussion of the models.

The research to be undertaken in this project falls generally into the category of research into teachers' thinking, and especially teachers' thinking whilst teaching. In this field a wide variety of theoretical perspectives has been adopted in recent years, and a brief outline of other work will explain the context in which this study is undertaken.

As mentioned earlier, it was not until the 1970s that researchers started systematically to study teachers' thinking. The work of Clark and Peterson (1986) was influential in the sense that it highlighted that what teachers do depends a great deal on what they think. Research into teachers' thinking is therefore necessary to develop an understanding of teaching. Calderhead (1981) also takes a psychological approach, but rejects models that construe teachers' decision-making as an information-processing activity.

Morine-Dershimer provides an overview of recent research on teachers' thinking. She outlines 'four of the most influential ... alternative interpretations of what it might mean to think like a teacher' and labels them as 'thinking through schemata', 'reflecting in/on practice', 'formulating pedagogical content knowledge', and 'perceiving practical arguments' (Morine-Dershimer 1990, in Brown and McIntyre 1993).

As an example of Morine-Dershimer's 'thinking through schemata' category, Brown and McIntyre (1993) present the model of Gaea Leinhardt who explored, in great detail and very systematically, the nature and structure of teachers' knowledge in the area of mathematics teaching. The model is explained in more detail in the section on 'further models'.

Each of the other three approaches to teachers' thinking identified by Morine-Dershimer is based to a large extent on the work and writing of Schön (1983 and 1987), but it has been most influential in relation to 'reflecting in/on practice', according to Brown and McIntyre (1993). Schön argued that thinking and expertise is based to a large extent on experienced-based knowledge and on thinking about what is applicable in particular situations. However, he did not base his research on classroom teaching and it is therefore not yet empirically established how helpful his 'reflection-in-action' is in relation to classroom teaching. His work has been important in relation to teaching in the sense that it has highlighted the importance of professional practice and shown that professional practice of high intellectual quality does not depend on articulated theory or on analytical thinking.

Morine-Dershimer's third category refers to the work of Shulman and associates. His model of teachers' knowledge is explained in detail below. However, Shulman does not claim that he attempts to describe teachers' thinking, but that he attempts to highlight important aspects of teaching. Brown and McIntyre (1993) assert that the notion of 'pedagogical content knowledge' (as well as the 'reflection in/on action' notion) suggests a way of interpreting teaching, possibly even certain approaches to teaching (such as transmission style). McEwan and Bull (1991) argue on the same grounds that there is not a distinction between subject knowledge and pedagogic content knowledge, that 'all knowledge is, in varying ways, pedagogic'.

The fourth of Morine-Dershimer's categories ('perceiving practical arguments') refers to her own work based on an approach proposed by Gary Fenstermacher (1986 in Brown and McIntyre 1993). She quotes Fenstermacher when reasoning that 'using research to help teachers change their minds about the ends and means of instruction was a more defensible application of research than merely training them to imitate the effective behaviour patters identified by that research' (pp.13 and 14 Morine-Dershimer 1990, in Brown and McIntyre 1993).

Because of the emphasis of many researchers on exploring teachers' knowledge in terms of its components, the approach for presenting individual models has been to examine first research that has dealt with individual components (Shulman model, Ernest model), and then proceed to models of integrated knowledge (for example, the model of Brown and McIntyre).

The Shulman model

Shulman (1986b) asserts that 'where the teacher cognition programme has clearly fallen short is in the elucidation of teachers' cognitive understanding of the subject matter content and the relationships between such understanding and the instruction teachers provide for students'. He terms the role of subject matter knowledge in teaching the 'missing paradigm' in research on teacher cognition, and argues that knowledge of teaching will not advance until this lack is addressed. His interest is mainly in the realm of teachers' subject matter knowledge and the role it plays in teaching, whilst acknowledging that teachers need to possess a 'specialised understanding of the subject matter, one that permits them to foster understanding in most of their students' (Wilson, Shulman and Richert 1987). Shulman (1986b) proposes a framework for analysing teachers' knowledge that distinguishes between different categories of knowledge, and he mainly distinguishes between three kinds of knowledge: subject matter knowledge; pedagogical knowledge and curricular knowledge. In later publications (Wilson, Shulman and Richert 1987; Shulman 1987) he offers other kinds of knowledge:

knowledge of subject matter;
pedagogical content knowledge;
knowledge of other content;
knowledge of the curriculum;
knowledge of learners and their characteristics;
knowledge of educational aims (purposes and values and their philosophical and historical backgrounds);
knowledge of educational context (character of school communities and cultures); and
general pedagogical knowledge (broad principles and strategies of classroom management and organisation).

Some of these components overlap with what Shulman had proposed earlier.

Shulman (1986a) defines 'subject matter knowledge' as 'the amount and organisation of the knowledge *per se* in the mind of the teacher' (p.9). The important part of Shulman's work is the

acknowledgement of 'pedagogical content knowledge' which helps to fill the gap of the 'missing paradigm'. He describes 'pedagogical content knowledge' as that knowledge 'which goes beyond knowledge of subject matter *per se* to the dimension of subject matter knowledge for teaching' and asserts:

Within the category of pedagogical content knowledge I include, for the most regularly taught topics in one's subject area, the most useful forms of representation of ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations – in a word, the ways of representing and formulating the subject that make it comprehensible to others. Since there are no single most powerful forms of representation, the teacher must have at hand a veritable armamentarium of alternative forms of representation, some of which derive from research whereas others originate in the wisdom of practice. Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons. If these preconceptions are misconceptions, which they so often are, teachers need knowledge of the strategies most likely to be fruitful in reorganising the understanding of learners, because those learners are unlikely to appear before them as blank slates. (Shulman 1986a, p.9)

Included in this category would be the specific knowledge of how the subject might be interpreted for learners, and the knowledge of how pupils think within specific (mathematical) domains (work within the cognitive science tradition readily fits into this category). Curricular knowledge is the knowledge of instructional materials available for teaching various topics. In essence Shulman proposes that the important components of teachers' knowledge are what they know about the subject, about how learners think about the subject, and about instructional materials developed to teach the subject. It is increasingly recognised that pedagogical content knowledge forms the essential bridge between academic subject matter knowledge and the teaching of the subject matter (Ernest 1989). For it is that knowledge which determines how the subject matter is represented to students in their learning experiences, and it includes the practical skills for transforming subject matter for teaching and the pedagogical knowledge and skills for teaching it. Interestingly, McEwan and Bull (1991) assert that all content knowledge, whether held by scholars or teachers, has a pedagogical dimension, and that therefore Shulman's distinction between content knowledge and pedagogic content knowledge cannot be supported.

Shulman's classification of teachers' knowledge has been proven to be very stimulating for research into teachers' cognitions. For example, Bromme (1994) who worked in Germany on mathematics teaching and learning took up Shulman's suggestions, but extended them by two further concepts: the 'philosophy of content knowledge'; and by distinguishing between the knowledge of the academic discipline and that of the subject in school. Within 'school knowledge' he includes goals about school and concepts of general education into the meanings of the subject-specific concepts. Banks and Leach (1996) also propose that school knowledge 'relates to the way subject knowledge is specific to schools'. By the 'philosophy of school mathematics' Bromme refers to 'the epistemological foundations of mathematics and mathematics learning and about the relationship between mathematics and other fields of human life', in other words teachers' perceptions on the nature of mathematics and its teaching. I show in my study (Pepin 1997) that, although teachers are not explicit about their perceptions on the nature of mathematics, teachers' beliefs on its nature are manifested in their classroom practices and that they are different in England, France and Germany.

The Ernest model

Ernest (1989) explores teachers' knowledge in mathematics teaching, and his model includes teachers' attitudes and beliefs. What is notable in Ernest's model is the importance ascribed to teachers' beliefs, in particular those concerning the nature of the particular subject (mathematics), and concerning the process of teaching and learning of the subject. He tries to develop a more fundamental understanding of how mathematics teachers' knowledge, beliefs and attitudes provide a basis for classroom teaching approaches. He specifies the essential knowledge, beliefs and attitudes of mathematics teachers (and the ways in which these affect the teaching of mathematics) as follows:

Knowledge

of mathematics;
of other subject matter;
of teaching mathematics (mathematics pedagogy, mathematics curriculum);

of classroom organisation and management of mathematics teaching;
of the context of teaching mathematics (school context, students taught);
of education (educational psychology, general education, mathematics education);

Beliefs

conception of the nature of mathematics
models of teaching and learning mathematics;
principles of education;

Attitudes

attitude to mathematics;
attitude to teaching mathematics.

Although this model is more detailed than that of Wilson, Shulman and Richert (1987), it shares many of its components with Shulman's model. The comparison provides some measure of support for Ernest's model, since there is evidently a great deal of overlap. Ernest's pedagogical knowledge refers to Shulman's knowledge 'which a teacher uses to transform and represent knowledge of mathematics for teaching' or pedagogical content knowledge (Wilson, Shulman and Richert 1987). A key difference between Shulman's and Ernest's models is the apparent neglect of attitudes and beliefs in Shulman's model. However, it seems that beliefs about subject matter are to some extent incorporated into Shulman's 'knowledge of subject matter'.

However, there are other models in which knowledge has been studied as an integrated phenomenon. There is a research tradition in education that studies teachers as experts. This approach analyses the connections between the professional knowledge and professional activity of good performers within a certain field of activity.

The model of Brown and McIntyre

Recent studies have sought to understand teachers on their own terms and in their own language by attempting to elicit the often implicit and only partially articulated elements of teacher knowledge that guide teachers' actions in specific situations. In this work on teachers' implicit theories researchers try to get teachers to talk about their work, combined with extended observations of teachers' work. The researchers attempt, on the basis of these verbal and observational data, to draw inferences about the content, the organisation and the development of teachers' craft knowledge.

For example, Brown and McIntyre (1993) developed a model based on the assumption that 'over a period of time experienced teachers have acquired substantial practical knowledge about teaching, largely through their classroom experience rather than their formal training' (p.12). Underlying this approach is the notion that teaching is a craft (rather than a science-based technology) and that experienced teachers have 'craft knowledge' which is accessible to others. In terms of teachers' professional development this means that teachers can share their diverse and successful approaches, a 'building on strength model' (Brown and McIntyre 1993). The purpose is to explore 'that part of (teachers') professional knowledge which teachers acquire primarily through their practical experience in the classroom ... which guides their day-to-day actions in classrooms, which is for the most part not articulated in words and which is brought to bear spontaneously, routinely and sometimes unconsciously on their teaching' (Brown and McIntyre 1993, p.17). They refer to this aspect of teachers' knowledge as 'teachers' professional craft knowledge'. This knowledge is studied by developing an understanding of how teachers themselves make sense of the knowledge and the thought that they use in their everyday classroom practice. Brown and McIntyre (1993) found out that teachers commonly judged their teaching in terms of 'the achievement or maintenance of states of pupil activity which they took to be normally desirable for particular phases and types of lessons (Normal Desirable States-NDS)' and each teacher had their own NDSs for their lessons and for phases of their lessons.

Further models

Another interesting model in the area of cognitive models of the skills of teaching has been the work of Leinhardt and her colleagues. Their goal has been to describe in depth the mental structures of skilled teachers. The underpinning belief here is that teaching is 'a complex cognitive skill amenable to analysis in a manner similar to other skills described by cognitive psychology' (Leinhardt and Greeno 1986, p.75, in Grouws 1992). After hypothesising a model of mental structures, they examined and contrasted the teaching behaviour of expert and novice teachers to see whether their behaviour fits their model. According to Leinhardt and her colleagues, the skill of teaching is to a large extent determined by two inter-related systems of knowledge: subject matter (content knowledge) and lesson structure (practical knowledge). The methodology involved observing teachers and then preparing detailed semantic nets of the mathematics presented (Leinhardt and Smith 1985 in Grouws 1992). According to Leinhardt and her colleagues teacher knowledge is made up of the skills and abilities needed to run classrooms well and to adequately interpret and explain certain procedural mathematical ideas in order that the students are able to acquire the mathematical skills that the teacher feels are important. Knowledge of content was important in Leinhardt's work and one of the major results was that expert teachers' knowledge appeared to be organised into a hierarchical structure, they used richer systems of representations and they tended to present more detailed conceptual and procedural knowledge.

Elbaz (1983) has provided another kind of model, that of knowledge as practical and personal. Her ideas stress the growing dynamic nature of teachers' knowledge. She suggested that it is necessary to recognise that knowledge is always changing and never static.

The work of Elbaz relates to a further kind of model, that of regarding teachers' knowledge as situated. In this model it is asserted that in-school knowledge is acquired by working alone, whereas out-of-school knowledge is acquired by working in a social situation to construct one's own learning. It is assumed that all knowledge is situated and that it is to a large extent a result of the activity undertaken, the context and the culture in which it is developed (Brown *et al.* 1989 in Grouws 1992). The concept of situated knowledge suggests that school-knowledge is different from real-world knowledge. Furthermore, it is suggested (Fennema and Franke 1992 in Grouws 1992) that the components of teachers' knowledge appear to be situated in the narrow environment of the

school and that the situating of teacher knowledge influences the way teachers make instructional decisions and what their students learn.

Comparing all these models of teachers' knowledge, one consistency across all conceptions is the view that knowledge is never static but continually changing and developing. Teachers' knowledge grows through interaction with the subject and with the students in the classroom, but also through professional experiences, amongst other components. Once this can be accepted, the challenge is to develop an understanding of this process and to discover what experiences contribute to the growth and changes.

The French scene

In France a distinction is made between *la pédagogie* (educational theory or pedagogy) and *la didactique* of a certain subject (for example, the didactics of mathematics is regarded as the science of teaching and learning mathematics). In simple terms, pedagogy is more general than didactics. The term pedagogy is generally used in terms of education and, according to Houssaye (1994, p.13), includes general educational theory, such as socio-psychological theory, for example. Didactics is, according to Henry (1990), in general terms 'the study of phenomena of the teaching and learning in one discipline' which specifically includes not only the teaching but also the learning of the subject. Thus, the term pedagogy is used in a much wider sense and not specialised on one subject, whereas didactics refers more precisely to the teaching and learning of a specific subject. In France the discipline of didactics of mathematics is a recognised discipline in education and is always associated with the teaching of the subject. Robert (1988) explains:

Une des ambitions de la didactique, a contrario, est d'essayer de préciser le plus scientifiquement possible les véritables marges de manoevre de tout ensignant de mathématiques dans sa classe, en analysant le fontionnement de l'ensemble su système et de chaque composante, puis de développer et d'étudier certains choix, juges optimaux dans la gestion globale et locale de la classe [One of the ambitions of didactics is to try to specify in the most scientific way the real possibilities for manoeuvre for all mathematics teaching in the class by analysing the functioning of the totality of the system and its components, and then to develop and study certain choices which are regarded to be optimal in the sense of general and individualised classroom management] (p.2).

Didactics (and pedagogy) are often presented in the form of a triangular model (see Henry 1990, or Houssaye 1994). Although this model is likely to be limited, it nevertheless establishes more clearly the objectives of the study of didactics.

The triangle has as its vertices the teacher, the pupil and the knowledge. These terms are of course generic in the sense that, for example, the term 'teacher' carries with it all the components of the educational system that assigns this role to him/her. 'Knowledge' means all available knowledge in mathematics, for example, including the school mathematics communicated through the curriculum, but also knowledge of its transformation for the purpose of teaching. (See also Chapter 8, p.110) The three axes of the triangle which link, for example, the teacher to the knowledge on the one hand and to the pupil on the other hand (and also the pupil to the knowledge), are represented by processes and conceptions which are now explained.

Teaching is represented by the link between the teacher and the knowledge. Teachers with their education and professional experiences take with them into the classroom a number of perceptions about their work, about the subject, about the teaching of the subject and about the pupils. These, in turn, influence the teaching of the subject. This axis also includes the epistemology of teachers

concerning their teaching. For example, in the 1960s, mathematics teachers in France were influenced by the Bourbaki movement and the 'New Maths' (see Moon 1986).

The relationship in terms of teaching between teacher and pupil is represented by the axis which links pupil and teacher. For example, studies on traditional teaching (in the sense of traditional transmission style) and, opposed to it, a more active approach explain some of the possible relationships.

The link between the pupil and the knowledge is represented by the process of learning. The cognitive psychologists have contributed a lot to the understanding of this link. For example, Jean Piaget asserts in his Theory of Equilibrium that a child periodically reorganises his/her knowledge by means of overcoming situations where s/he was confronted with problems. He therefore puts the action as the determining factor for learning. For the mathematics educators, the action consists of problem solving and this is regarded as the essence for the learning of mathematics. But in this link between the pupil and the knowledge, one also has to understand the role of barriers to learning which manifest themselves in mistakes. Mistakes are important in the sense that they produce a break and in turn allow pupils to review their knowledge or procedures. Moreover, the teacher's attitude towards mistakes reveals his/her perceptions of the learning of mathematics.

Research into general didactics, and the didactics of mathematics in particular, has developed certain concepts around which all present work evolves. In the French research on the didactics of mathematics, there are two distinct, but interrelated, theoretical fields: the theory of *didactical transposition*, based on the work of Chevallard since the 1980s (Chevallard 1991); and the theory of *didactical situations*, developed by Brousseau (1986) since the beginning of the 1970s and developed by subsequent researchers since. The didactics of mathematics is seen here as the study of the issues of the preparation of mathematics for students.

The two theoretical approaches concern fundamental but different levels of didactical analysis. Artigue (1994) asserts:

... the theory of didactical transposition concentrates on the analysis of these processes that are based on reference knowledge, particularly on the reference knowledge produced by the legitimizing mathematical institution (scholarly knowledge), that lead to objects of teaching (knowledge to be taught) that are found in the daily life of the class (taught knowledge). It tries to go beyond particular studies and highlight certain laws and regularities in these complex transposition processes. ... To a certain extent, the theory of didactical situations is situated at a more local level. It aims to model teaching situations so that they can be developed and managed in a controlled way. (p.28)
However, both theories emphasise the need to view the study of didactics by acknowledging the systemic features. Therefore, to prepare mathematics for students is perceived as a didactical task that requires a more global systemic analysis (Artigue 1994).

The concept of the *transposition didactique* (Chevallard 1991) is explained as the process from the *savoir savant* (scientific knowledge – knowledge which is accessible through books and magazines and generally accepted as knowledge by the research community) to the *savoir enseigné* (taught knowledge – knowledge proposed to pupils in the form of textbooks, for example, or that adopted in class in order to foster pupil learning). This process of transforming subject knowledge into taught knowledge is, of course, the very process that Shulman calls for when referring to pedagogical content knowledge. Therefore, by adopting the *didactical transposition* approach, one acknowledges the institutions at the source of knowledge.

On the other hand, the approach via the theory of *didactical situations* concentrates on a narrower system: the didactical system built around the teacher and his/her students, and situated within the society in which the teaching system is located. This theory is based on a constructivist approach, in the sense that knowledge is constructed through adaptation to a 'problematic' environment ('disequilibrium' stage). It aims to become a theory for the control of teaching situations in their relationship with the production of mathematical knowledge. The didactical situation is, therefore, made up of mainly three components: the teacher, the pupil and the knowledge. The aim is to develop the conceptual and methodological means to control the interacting phenomena and their relation to the construction and functioning of mathematical knowledge in the student (Artigue 1994).

Two of the main concepts in this field are the *contrat didactique* and the *contrat disciplinaire*. The concept of the *contrat didactique* (initiated by G. Brousseau in the early 1980s) concerns the relationship between teacher and pupils. He specifies:

... nous appelons contrat didactique l'ensemble des comportements (spécifiques) du maître qui sont attendus de l'élève et l'ensemble des comportements de l'élève qui sont attendus du maître [… We call didactical contract all the (specific) behaviour of the teacher which is expected of him/her by the pupil, and all the behaviour of the pupil which is expected of him/her by the teacher] (in Houssaye 1994, p.41*).*

Colomb (in Houssaye 1994) describes two models of this didactical contract and asserts that teaching now is situated somewhere within the range between those two models which represent the two extreme ends of the range. In the first model the teacher is the guardian of a body of knowledge, and the pupil is expected to adapt his/her knowledge to the body of knowledge presented to him/her. This implies most of the time that the pupil has to suppress and negate his/her own understanding. In the second model the teacher delegates the whole responsibility in terms of knowledge to the pupil who is expected to construct knowledge from his/her own understanding.

The second concept, that of the *contrat disciplinaire,* is described in a similar form as the *contrat didactique*. Colomb (in Houssaye 1994) defines it in the following way:

… nous avons introduit le concept de contrat disciplinaire: 'Ensemble des comportement du maître qui sont attendus de l'élève et ensemble des comportements de l'élève qui sont attendus du maître dans une discipline au cours d'une année scolaire'. […the whole behaviour of the teacher expected by the pupil and the whole behaviour of the pupil expected by the teacher, in one subject over the course of a school year] (p.46).

In terms of more concrete concepts of teaching and learning there exists a wide literature in the area of mathematics education in France. According to the literature, at the beginning of the 20th century the traditional concepts of teaching were based on perfect exposition (and transmission), repetition and calling on pupils' memory rather than understanding. Traditionally teaching has been based on the 'empty vessel' (or 'incremental steps') views, but the literature now supports and encourages the 'constructivist' view. In other words, there has been a shift in the literature towards a constructivist view of learning.

Mante (1989) has produced a critique of the traditional perception and presented a constructivist concept in terms of their limits and espoused views, which represents this shift well. He also proposes the triangular relationship between the knowledge taught, the pupil and the teacher, and asserts that behind every learning situation there are certain perceptions of learning involved. He defines three

perceptions of learning: the perception of the 'empty vessel'; that of 'little steps'; and the constructivist view. It would be too lengthy to explain the three concepts in detail, but it might be interesting to connect them to concepts of teaching which are commonly known in England, France and Germany.

At the extreme lies the *cours magistral* (traditional teacher-led, lecture-type lesson) where the teacher transmits the content without concern about what is learnt. The traditional French *cours magistral* is an example of the concept of the 'empty vessel'.

An example of the concept of 'little steps' is the lesson where the teacher gives the pupils a large number of relatively easy examples and exercises, in order for the pupils to understand the essence of the lesson. Some computer-assisted teaching schemes work in this way.

Examples of the constructivist concept are situations where teachers provide pupils with investigative activities. However questions emerge of, for example, initial perceptions of pupils about the subject matter. Mante (1989) suggests that mistakes can help teachers to discover pupils' initial perceptions. There are also questions over which role the teacher takes in this scenario. These relatively recently emerging concepts of teaching in the constructivist way are perhaps rare, but teachers are encouraged (by inspectors, in-service courses, journals and textbooks) to try them out (see Pepin 1997).

By looking at these theories and concepts of didactics in France one can detect at least two underpinning beliefs: firstly, that for a teacher just knowing the subject matter is not sufficient for teaching the subject; and secondly, that there are underlying common processes in learning in school (common to most pupils) which can be made evident. These two assumptions give rise to the demand for investigating into teaching and learning (a specific subject), and for making this a scientific discipline, *la didactique*.

When comparing France (and the French cultural traditions, such as egalitarian views, for example) with England (and the English cultural traditions, such as individualism, for example) one starts to understand why there have not been developments towards didactics in Britain. Didactics is based on the assumption that there are common processes involved in human learning. If this assumption is negated, because of individualistic views, this explains in part why didactics, or a science of teaching, could not develop in Britain. This was earlier described as the 'missing paradigm'. Simon (1994) argues that for 'a combination of social, political and ideological reasons (for example, the British public schools which dominated educational institutions for a long time had no regard for pedagogy in the sense of a systematic and rational approach to teaching a certain subject)' (p.14) pedagogy has 'never taken root and flourished in Britain'. Based on the recognition that there is a human capacity for learning and that the process of learning among human beings is similar across the human species as a whole, he calls for 'a renewed understanding both of the power of education to effect human change and especially cognitive development, and of the need for the systematisation and structuring of the child's experiences in the process of learning' (pp.16, 17). As a result he accuses the child-centred approaches (for example, propagated by the Plowden Report (1967) in England) of starting from the 'wrong' position (individual differences). Simon (1994) explains that in order 'to develop effective pedagogy means starting from the opposite standpoint, from what children have in common as members of the human species, to establish the general principles of teaching and, in the light of these, to determine what modifications of practice are necessary to meet specific individual needs' (p.18). He believes that the aim is to develop skills and abilities in all children which in turn involves 'importing a definite structure' into the teaching and thus into the learning experiences of pupils. In his view and from the social point of view, the means of promoting human qualities and characteristics cannot be left to individual teachers 'on the grounds that each individual child is unique so that the development of pedagogy is both impracticable and

superfluous' (p.20). According to him, teachers need 'assistance in the pursuit of their common objective – the education of a new generation of pupils' which requires 'carefully defined goals, structure and adult guidance' (p.20).

Therefore, according to Simon's theory, didactics are necessary on the basis of egalitarian assumptions and for the purpose of educating the greatest number in the 'best possible' way. What is interesting in this sense is that recently in France where the education system has been centralised and didactics has been well developed, the tendency is to 'go individual' (in the sense of attending to the needs of the individual child and to see the class as being constituted of 30 individuals). In England, where individualism in education has been well-rooted over the decades and no didactics has been developed, the recent tendency is to 'go common' (in the sense that whole-class teaching is advocated, therefore to see the class as a whole).

Another point to be made here is that by looking at the models of teaching and learning in England and France, it seems that the Anglo/American research has been more empirically based than the French. The theoretical conclusions drawn from the Anglo/American research appeared to have emerged straight out of the empirical data. This belief in empiricism, research and theoretical conclusions on the 'here and now' (together with the belief in individualism) did not appear to allow researchers in England to develop a construct such as that of didactics. In French didactical research it seems as if there has been another layer of abstraction, in order to organise the thinking (for example, constructs such as *transposition didactique*), although didactical constructs are informed by empirical research. This point is taken up later when comparing German didactics with American research in teaching.

Furthermore, another issue concerns the distinction between didactics and pedagogy, and their links. As didactics does not appear to exist in England, one cannot look for clues in the 'pure' British or American literature. The French literature, however, has given a starting point (that pedagogy is wider cut than didactics). It asserts that didactics mainly concentrates on the teaching and learning process of a particular subject in class, in the sense that it does not encompass pedagogical problems such as discipline problems in class, or general motivation. Tochon and Munby (1993) give an interesting explanation in this respect: they define didactics as 'the organisation of subject-matter knowledge through time as a preactive or postactive anticipation (before or after the classroom interaction synchrony), whereas pedagogy stems from the interactive management of time' (p. 206). Leinhardt and Greeno (1986) called didactics and pedagogy the teacher's 'double agenda'. In this sense didactics deals with 'content processing which implies planning a sequential time, while pedagogy is concerned with students' relationships to knowledge and behavioural actualisation of teaching within real time' (Tochon and Munby 1993). In other words, didactics is concerned with the preparation and teaching of a specific subject (even topic) which also implies considerations on the learning process (see Piagetian ideas in France, for example), whereas pedagogy is concerned about the 'here and now' of teaching in order to accommodate the varying context of teaching itself.

The German *Didaktik*

There have been several authors (for example, Kansanen 1995a, Hopmann and Riquarts 1995, Hamilton and Gudmundsdottir 1994) who have written on issues concerning the dialogue between the German *Didaktik* on the one hand and the American research on teaching and the curriculum traditions on the other hand. In this section the different views are explored in connection with what are regarded as significant curriculum-didactics debate, and how these compare with the particular traditions.

As in French didactics literature, in Germany a core concept in the development of didactics has been the *Didactic triangle* with its three components of the content, the learner and the teacher, in order to structure the field of didactic research and theory. This shows that the common strand is the belief in an integrative approach, in the sense of including the subject to be taught, the student and the teacher into the research on teaching and learning.

According to Kansanen (1995a) there are several theoretical models which developed over the centuries and which can be regarded as the main traditions of the German *Didaktik*. At the beginning of the 17th century there was the 'founder' model of Ratke and Comenius, which regarded didactics as the art or study of teaching (*Lehrkunst*). During the following centuries the influence of Herbart altered the position of didactics, in the sense that he turned didactics into a discipline of its own (instruction under the conditions of schooling as distinct from general educational theory, such as education in the family). Whereas Herbart himself argued for an active interplay between the three components (teacher, student and content), Herbart's followers changed his analytical tools into formal stages of instruction. Every hour and minute of the lesson was supposed to follow the same pattern (an example is the Prussian school routine). At the beginning of the 20th century 'reform pedagogy' influenced the new modes of thinking. The aim was an 'animated, multifaceted education' (Hopmann and Riquarts 1995) with child-centred activities. Kerschensteiner, Gaudig and Petersen were its main representatives. On the theoretical side, a theory of education and teaching emerged, *geisteswissenschaftliche Didaktik*, which built on the philosophy and pedagogy of Dilthey. Its main representatives were Nohl, Weniger and Klafki. This new didactics did not find many followers in non-German speaking countries and therefore became an almost entirely German concept. In the early 1960s the Berlin School (Heimann, Schulz, Otto) proclaimed an empirical-analytic paradigm amongst didactic theories which professed explicit connections with Anglo-Saxon research on teaching. In addition, Habermas initiated another alternative approach, the critical-communicative didactics, which was based on critical theory. These relatively recent theoretical models have had numerous variations and didactics has kept close contact with teacher education.

The American tradition of research on teaching can be traced back to pragmatism and representatives such as Spencer, James, Dewey and Heard. Its fundamental interest was practical by nature. The predominant approach within research on teaching has been to start from the assumption that there are 'expert' teachers and to identify and determine those factors which are crucial in those teachers' practice. In order to develop theoretical models empirical research (mainly quantitative) has been conducted and models have been tested in classroom situations (mainly based on the process-product paradigm).

Hopmann and Riquarts (1995) argue that the American educationists of the late 19th century cherished Herbart, but not the reform pedagogues who came after him, and therefore ignored the rise of changed didactics developing in Germany. The term didactics disappeared from the terminology, except for the 'didactical' teaching of the Prussian, pre-reform pedagogy period. According to Hopmann and Riquarts (1995) educationists like Dewey did not take from Herbart the whole of didactics but only the educational psychology that underpins it. Herbart became one of the founders of American educational psychology. With the psychology of education as the main background discipline, learning problems, for example are of major importance. The subsequent practical approach in American research in education centred around empiric-analytic research on learning, motivation or assessment, for example. It is claimed (Kansanen 1999) that the practical approach has neglected the importance of research into the content of the curriculum and its teaching.

The 'curriculum' tradition is often contrasted to German didactics. According to Mitter (1981) the term 'curriculum' should be related to two 'core' terms used in German educational theory and

practice, namely to *Didaktik* and *Lehrplan* (syllabus). He asserts that didactics is concerned with the pedagogical discipline dealing with the principles of education and subject matter. The original approach to didactics was derived from educational philosophy (as we have already seen) and therefore not necessarily linked to teaching and learning strategies, whereas the contemporary approaches are informed by learning theory, amongst others. The syllabus is the 'normative framework for what has to be taught and learnt in schools' (Mitter 1981). It is usually restricted to the definition of aims (in a generalised form in the preambles) and the specification of subject matter. On the other hand the Anglo-American term 'curriculum' refers to an integrated model including several or all of the following: the definition of aims and objectives; the selection of subject matter; the choice of adequate organisational forms, media and methods; the implementation of materials; and the evaluation of the implementation process (Mitter 1981). The application of the term 'curriculum' was based on the American idea of *Reformpädagogik* by Dewey whose focus was on the individual pupil and his/her learning experiences. The curriculum was, therefore, defined through learning experiences, it focused on the individual pupil and his/her learning experiences at school.

In 1967 Robinsohn introduced the term 'curriculum' into the German didactics debate and since then the terms 'curriculum' and 'curriculum theory' have been competing with traditional German terms in educational discussions, with the result that sometimes the term 'curriculum' is used for 'syllabus' and 'curriculum theory' for 'didactics' (Mitter 1981). According to Klafki (1974 in Kansanen 1999) it seemed as if *Didaktik* would be included in the more general concept of curriculum. Eventually in the early 1980s didactics and curriculum were accepted as parallel areas (Kansanen 1999). Kansanen (1995b) concludes that 'the didactic aspects of curriculum have integrated into *Didaktik*', but that there is 'hardly any evidence of impulses in the opposite direction'.

Kansanen (1995b) summarises the developments in America and Germany in the following way:

... it can be said that the erudition-centred Didaktik did not gain footing in the USA in the beginning of this century. Instead, the reflection on teaching continued in psychology of education. In Germany reform pedagogy transformed [the Herbartian didactics] into erudition-centred Didaktik which got later some rival directions. The empiric-analytic approach did not succeed in getting a breakthrough in Germany in spite of a good beginning ... It lived some time as descriptive Didaktik but did not develop into psychology of education. The latter got its impulses from the USA and has been a separate area alongside Didakti (p.108).

What can be seen from the above developments is that '*die Didaktik'* in Germany has always been a form of philosophical thinking, theorising and the construction of theoretical models' (Kansanen 1999), whereas American research into teaching has been more empirically based. Comparing the descriptive *Didaktik* and Anglo-American research on teaching, Kansanen (1995a) argues that the difference between the two is 'in their background or in the purpose of their model building'. He claims that *Didaktik* is of 'genuine German origin' and based on 'philosophical traditions of its own with such names as Kant, Herbart, Schleiermacher, etc'. He asserts:

Didaktik is mainly intended for teacher education and the models are based on a philosophical conception of man and on the nature of research concerning his education. The empirical research results are not a prerequisite for model-building, but are used in a corrective way when they are in conflict with the model variables. Research on teaching reflects an empirical tradition and that is why its models are mainly inductive by nature and based directly on research results. Practical conclusions can, of course, be drawn from these models and thus they can also function in teacher educatio (Kansanen 1995a, p.348).

However, there is an empirical side of research into teaching in Germany, *Unterrichtsforschung*. Kansanen (1995b) claims that Didaktik subsumes *Unterrichtsforschung*, and that it appears that the more empirical elements are in a model of Didaktik, the more references can be found to American research on teaching

The emergence of research on what constitutes teachers' knowledge in a particular subject has created the *Fachdidaktik* (subject didactics) which denotes the pedagogical transformation of factual content for the purposes of teaching, taking into consideration all factors of the teaching-learning process. As mentioned earlier, in the French comparison, a comparison between pedagogical content knowledge and *Fachdidaktik* might produce fruitful discussions.

Referring back to the discussion of pedagogy and didactics, education can usefully be split into the two sub-areas of pedagogy and *Didaktik*. According to Shulman (1987) and Simon (1994), the sub-area of didactics appears to be missing. Kansanen (1995b) claims that much of its content belongs to educational psychology, and that in American literature of research on teaching 'the problems of teaching and learning in general are usually held together without any theoretical model building'. The theoretical background in terms of philosophical questions is discussed when a suitable methodology is selected. Whereas in Germany *Didaktik* and educational psychology are clearly separate fields, in the USA the same people can be working in both areas, which influences the aspects of research chosen in the sense that there is more emphasis on the aspects of learning in the teaching process than in Germany.

Concluding remarks

There are at least two conclusions that can be drawn from the comparison of existing representations of knowledge in teaching in the Anglo/American, the French and the German educational scene. Firstly, there appears to be a commonality amongst representations of knowledge in teaching in the sense that it is not seen as static, but as a process of development, that it grows and changes, and that experience in the classroom contributes to its growth and change. Secondly, there seem to be differences in traditions within the research into knowledge of teaching. The German (and French) educational research into teaching appears to be traditionally concerned with philosophical thinking, theorising and the construction of theoretical models, the *Didaktik* (which is nevertheless informed by empirical research). Anglo/American educational research is to a large extent based on empirical studies, in order to identify and be able to determine factors that are influential for teaching (and learning) and to develop an understanding of the processes involved in teaching and learning.

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Didaktik/fachdidaktik as integrative transformation science(-s) – a science/sciences of/for the teaching profession?

Abstract

Most conceptions of professionality (e.g. functionalist, system-theoretical, structuralist) stress the relevance of the existence of (a) corresponding, well developed science(-s) and of (scientifically) validated practices for a particular (academic) profession. The fulfilment of these criteria has remained an open question for the teaching profession, although much (scientific) knowledge and some (scientifically) validated practices relevant for teaching and learning in schools and the teaching profession have been developed. This knowledge has mainly been produced by Erziehungswissenschaften ("educational sciences") and its subdisciplines (e.g. Didaktik, educational psychology) as well as by various Fachdidaktiken ("subject-related didactics") for different subjects taught at schools. Questions will be raised about the status of different types of knowledge produced and their relevance both for teacher education (TE) and the teaching profession. A (preliminary) model of "Didaktik/Fachdidaktik" (DF) as an integrative transformation science dealing with teaching/studying/learning will be presented. The potential of DF to become a science/sciences of/for the teaching profession and some measures perceived to be necessary to approach it will be discussed.

Preliminary remarks

As a concrete outcome of an all-European and European Commission supported project (Sigma) on the evaluation and perspectives of a number of higher education studies the European Commission has established so-called thematic networks within the Socrates programme. The report on the evaluation and perspectives of TE in the Member States of the European Economic Area has been submitted by T. Sander *et al.* in 1996. Established in 1996 the Thematic Network on Teacher Education in Europe (TNTEE) may be seen as a large network dealing with core problems of TE in a number of subnetworks. These subnetworks may be understood as meeting places for teacher educators and researchers aiming at improvements of TE both theoretically and in concrete all-European projects.

One subnetwork of TNTEE (subnetwork E: Didaktik/Fachdidaktik as science(-s) of the teaching profession?) focusses on the role of Didaktik ("didactics") and Fachdidaktik(-en) ("subject-related didactics") and their potential to contribute to the improvement of the quality of teaching/learning

both at schools and in TE. Additionally, this subnetwork explores the potential of Didaktik/Fachdidaktik to become a science for the teaching profession. So far, this subnetwork, consisting of experts from different academic disciplines and coming from 11 European Economic Area Member States, has published a heterogeneous collection of more than 20 publications on its topic. This chapter may be seen in relationship to ongoing work of the subnetwork mentioned. It is both a modified and enlarged version of the publications "Scientific bases of initial teacher education and their relevance to evaluate it – between the state of practice and the state of the art" (Buchberger 1998c) and "Didaktik/Fachdidaktik as science(-s) of the teaching profession?" (Buchberger and Buchberger 1998).

Introduction

Ironically, one might state that education and training have increasingly become big super-markets. Education policy – as well as social policy – and economic policy documents unanimously stress the necessity of human resource development and of high quality education and training for all (cf. European Commission 1995, 1997, OECD 1996, 1998). It is argued that the prosperity of post-industrial information and knowledge driven societies would depend on the optimal development (and exploitation) of the human capital of all its citizens and that these societies had *"to transform themselves into dynamic learning societies"* (OECD 1996). Substantial reforms of education and training are perceived to be indispensable. Focussing on traditional *"more of the same – rationales"* (modification – and adaptation strategies) to improve or to make education and training more efficient is perceived as inappropriate (OECD 1996) considering the amount of problems persisting and the rapidly changed/changing contexts (e.g. "globalization", cf. Amin 1997, Beck 1997) and conditions (e.g. the multimedia revolution, cf. Tella 1998) of and expectations of education and training.

Policy documents frequently stress the important role education and training establishments, teachers and their education had to play to meet these challenges adequately and to realize education and training reforms perceived to be necessary. H. Judge (1998, vii) has described the status quo of education reform and the role of teacher education (TE) in the United States in his foreword to the evaluation report on the Holmes Commission/Partnership activities (cf. Fullan *et al.* 1998) as follows: *"The most salient change since 1986 has without doubt been the installation of teacher education reform at or near the head of every agenda for educational regeneration: a hitherto neglected or subordinate theme has become dominant. Just as it has emerged as a commonplace that reform cannot be achieved without good teachers, so it has become axiomatic that good teachers need and deserve a first-class preparation"*. But, at the same time J. Sikula (1996) has stated in his introduction to the second edition of the "Handbook of Research on Teacher Education" that schooling and teacher preparation have not been high priority issues in American education policy yet.[1]

Parallel with developments in the United States, policy documents of the European Commission stress the importance of high quality education and training for all and the role teachers and TE ought to play. "Quality"[2] of education and training in general and of TE in particular had to be improved. Reforms of TE perceived to be indispensable had to relate to aims and objectives, contents and learning areas, teaching/learning strategies and learning environments as well as to administration and governance issues. However, coherent action cannot always be detected – both at European Commission level and at the level of the different Member States of the European Union. Despite rhetorical agreement on education and training reform in general and TE reform in particular being indispensable for education reform, neither rank top on the political agenda of the European Commission nor on those of most of its Member States (cf. Buchberger 1998a, b).

However, there seems to exist broad agreement on the relevance and importance of the best education possible making use of the best knowledge available. This calls for coherent efforts to produce scientifically validated knowledge and practice. Efforts to produce scientifically validated knowledge and practice neither contradict, nor do these imply a devaluation of, the relevance of other types of knowledge relevant to education (e.g. tacit knowledge of education practitioners). As both models of (simple) applications of explanatory knowledge ("theories") and of knowledge transfer have proved to be rather inadequate (cf. Radtke 1996), problems of different types of knowledge and their relevance for (professional) educators as well as of knowledge transformation have found more attention – a new challenge for TE and educational research? In every case it seems to be necessary to professionalize[3] (teacher) education by adopting scientifically validated knowledge and practices in approximating the best education possible. Most conceptions of professionality (cf. Combe, Helsper 1996) include as one defining concept the existence of a well-developed science of/for a particular profession. If teaching is to be understood as a profession, it needs clarification as to which science it is and how well this science is already developed.[4]

(Comparative) Research on TE and its reform (a rather poorly developed field in most Member States of the European Union) has highlighted both a large number of (persisting) problems of TE (e.g. problems with theories of TE as well as methodologies adopted in TE, problems with a research-based knowledge base of/for the teaching profession or with appropriate teaching/learning strategies) and a (sometimes rich) potential to improve it (cf. Sander *et al.* 1996) – sometimes with big differences between the different Member States of the European Union.

Against this background this article will mainly deal with the scientific knowledge bases of TE. It will focus on the role of "Didaktik/Fachdidaktik" (DF) as a possible science for the teaching profession.

Without going into detail some remarks on terminology should be made in advance:

(i) The concept of science (Wissenschaft) will be used in a rather liberal form following meanings attached to it in continental European cultural contexts. It will not be restricted to "natural sciences".
(ii) The concepts Didaktik as well as Fachdidaktik(-en) (literally translated as "didactics" and "subject-related didactics") are closely related to the German Geisteswissenschaftliche Paedagogik and the concept of Bildung (cf. Kron 1994, Seel 1999). This fact may be considered in relation to problems of intercultural (mis-) understanding.[5]
(iii) Both the (double) notion of Didaktik/Fachdidaktik and the singular/plural with science(-s) reflect uncertainties and may be interpreted as unsolved problems.[6]

In a general form DF will be defined as (a) science(-s) of teaching and learning (in a learning formation/places currently called "schools"). It will be conceived as a transformation science dealing integratively with:

(i) contexts of teaching, studying and learning
(ii) aims and objectives of teaching, studying and learning
(iii) contents of teaching, studying and learning
(iv) teaching and learning strategies
(v) media and teaching/studying/learning aids
(vi) evaluation of teaching, studying and learning
(vii) actions of actors involved in the teaching/studying/learning process

While there seems to exist some broader agreement on the topic of DF as a science (of teaching and learning) and to a smaller extent on the seven areas mentioned, the notions "transformation science" and "integratively" will be elaborated on in this article.

As a science DF aims at the production of

- descriptive knowledge/theories (Beschreibungswissen)
- explanatory knowledge/theories (Erklaerungswissen), and
- efficiency-oriented knowledge/technological theories (knowledge and measures to provide opportunities for change) (Veraenderungswissen)

In producing Veraenderungswissen DF may be seen as a "design science". While research on teaching and learning has focussed on the production of descriptive and explanatory knowledge, the production of technological theories for teaching/studying/learning may be seen as a blind spot (and some education researchers even doubt whether in education technological theories may be possible, cf. Alisch 1995).

This article does not provide answers or solutions. It aims at the definition of some main elements of the problem-space. The space available does not permit much detail and this may lead to some misunderstanding, considering the very different background knowledge accumulated in the different cultural contexts of the European Union (compare, for example, the different problem-definitions in England, Finland or Germany). Additionally, this article has to be restricted to some main components of initial TE (ITE), although the authors are very well aware that TE has to be conceived as a continuum and that in dealing with ITE one must always consider conceptions of the (professional) role of teachers and their professional development (cf. Buchberger 1994, 1996; Oelkers 1997).

Within this framework six statements will be discussed in section I and some measures will be described which might contribute to the development of a science of/for the teaching profession (section II).

I
Between the "state of practice" and the "state of the art"

Six statements will be presented to outline the recent situation of ITE (1–4), to describe a concept of DF as integrative transformation science (5) and to define some requirements to develop it (6). These six statements are as follows:

(1) Teaching and ITE have to be oriented on the "state of the art"
(2) The "state of practice" of ITE may be characterized as somewhat problematic
(3) (Research-based) Knowledge bases for teaching and ITE do exist, but are used to a limited extent only
(4) More research on teaching and ITE is indispensable to increase the scientific bases on teaching and ITE both in quantity and quality
(5) DF conceived as an integrative transformation science might have the potential to become the main science of/for the teaching profession
(6) Producing and adopting scientific knowledge bases to improve teaching/learning and ITE calls for co-operative problem-solving processes of all the actors involved

Teaching and ITE have to be oriented on the "state of the art"

This first statement will be introduced by a fascinating court case from the 1930s in the United States, involving the T.J. Hooper, a tugboat. This court case has been described in the preface to the AACTE publication "Knowledge Base for the Beginning Teacher" (cf. Gardner 1989):

"The T.J. Hooper and the ship it was guiding got into trouble in the Atlantic Ocean when a storm blew up. The storm damaged the ship and caused injury and property loss to its clients, who promptly sued. At the time common practice among tugs was to get weather information via hand signals from shore. Although radio had been introduced it was not common in use. The T.J. Hooper did not use radio, but if it had, the tug master would have known of the danger and been able to take its clients to shelter, thus avoiding damage to life, limb and property. The case turned on the question of T.J. Hooper's responsibility: was adherence to common practice (e.g. hand signals) enough or did the situation demand "state of the art" (radio)? The courts ruled that, when important matters are at stake, the legal obligation is to use the state of the art. The T.J. Hooper case has been effectively used by educational authorities to demonstrate that in the United States, where schooling of the young is involved, schools must use the state of the art techniques and materials".

In principle, the situation in the Member States of the European Union does not differ substantially from that in the United States. The importance attached to education and training in a "knowledge-driven society" calls for "state of the art" solutions.[7]

The "state of practice" of ITE may be characterized as problematic

Leaving teaching and learning at school aside, let us focus on ITE and start again with a statement of H. Judge (1990, 11): *"Teacher education (in England and Wales) is a product of history rather than of logic"*, adding that much progress might have been made in the past few years. This statement seems to hold true for most of the TE systems and programmes in the European Union and it refers to substantial curricular problems of ITE programs.[8] It might be argued that theoretical and research-based argument, as well as rational system planning or the expertise of those involved in ITE, have not always played the most prominent roles in constructing and developing systems and models of ITE. To be more explicit, most programmes of ITE in the Member States of the European Union are based primarily on some form of common sense, beliefs, opinions and (unrealistic) expectations (idealizations, illusions) (cf. Buchberger 1994, Oelkers 1997). They combine studies in certain academic disciplines with some methodology courses, some (teaching/school) practice and some educational/professional studies. These components, as well as their different (and sometimes rather peculiar) combinations, frequently neglect the state-of-the-art knowledge on:

(i) teaching, learning and TE (cf. Dick 1994, Oser 1997, Shulman 1987)
(ii) sociology of knowledge (cf. Radtke 1996) or
(iii) educational psychology (cf. Reusser 1994).

They may be seen as "collection code curricula" consisting of fragmented components with sometimes unclear relevance to teaching and learning, and as rather outdated "technology". Obvious difficulties are frequently circumscribed with the fig leaf formula "theory-practice-problem". Additionally, these common sense based (curricular) models of ITE may be seen as an enormous waste of resources.[9]

Curricular problems of ITE may be explained in many different ways:

(i) T.Popkewitz (1993) speaks of a "social arena" of TE where different interest groups and lobbies try to keep their influence in a social "power game" (e.g. scientific/academic disciplines) and in which adaptations and re-orientations which are necessary because of changes in the context are not made.[10]

(ii) General systems theory (Luhmann 1984) and a tendency of systems towards inner-systemic differentiations increasingly neglect the systems environment. Reluctance towards substantial curricular changes may be explained in this way.

(iii) Educational sciences (including educational psychology or educational sociology) and especially a science of teaching, as relatively young academic disciplines, could not really establish themselves in many ITE curricula.[11]

(iv) A science of the teaching profession may be seen as not very well developed while much normative (not to say dogmatic) argument and lay technology (not tested on its effects) seems to dominate, especially as regards methodology.

(v) A lack of pro-activity of institutions and staff of ITE who are not always aware of both the changing context of education/TE and the state-of-the-art knowledge produced in relevant academic fields of study.

(vi) Problems with the recruitment and the career structures of staff in institutions of ITE. While decisions to become a teacher are sometimes perceived as "second best choices of the second best" (cf. Neave 1992), academic careers in TE do not seem to have the most prestige in academic circles.

Similarities to the curricula of ITE apply to the learning cultures adopted in many programs of ITE. Research on teaching and TE has highlighted the importance of the concept of "powerful learning environments" (cf. Buchberger *et al.* 1994). But, the evaluation report on TE in the European Union (Sander *et al.* 1996) clearly indicates that many programs of ITE are by and large oriented on outdated knowledge transmission models – a "preaching water and drinking wine-phenomenon"? Similarities apply to problem-, project- and research-oriented learning processes in ITE, which are missing from many models of ITE in the European Union (cf. as an exception the model of ITE adopted in Finland, Buchberger 1995).

As regards the practical/clinical component of ITE programmes, rather outdated apprenticeship models, or models oriented on the "practice-relevant experiences", formula seem to dominate. Again, knowledge and practices available to provide "powerful learning environments" for prospective teachers to acquire a flexible repertoire of teaching actions is used to a limited extent only. Although a coherent and supervised teaching practice component provided by specially educated staff (in co-operative problem-solving groups) may be seen as a necessary condition for high quality ITE (e.g. Brenn *et al.* 1997), most models of ITE do not adopt the knowledge bases and scientifically validated practices available.

A coherent knowledge base component, an elaborated clinical component and a research component as well as their integration within ITE programmes are still missing. It would be easy to continue with a long list of examples of the methodological shortcomings of ITE. In short, ITE programs do not make intensive use of research-based knowledge and scientifically validated practices, and this fact is closely related to the unclear aims and goals of ITE (cf. Kennedy 1990), which include superficial and sometimes irrelevant content, sub-optimal methodologies and inappropriate learning cultures which are counterproductive to aims declared.

It is worth mentioning that some models and programmes of ITE in Member States of the European Union may be seen as counter-examples to what has been outlined. This is true in many ways of ITE at Finnish universities (cf. Buchberger 1995). In addition some promising approaches all over the European Union may bring about an improvement in the quality of ITE.[12]

(Research-based) knowledge bases for teaching and ITE do exist, but are used to a limited extent only

Much research-based knowledge has been developed on teaching and learning and to a smaller extent on several aspects of TE (e.g. *The Handbook of Research on Teaching* edited by Wittrock 1986, *The International Encyclopedia of Teaching and Teacher Education* edited by Anderson 1995, *The Handbook of Research on Teacher Education* edited first by Houston 1989 and then by Sikula *et al.* 1996, or *The Knowledge Base for Beginning Teachers* edited by Reynolds 1989). The use of this knowledge in teaching/learning in education at school or in TE programmes may lead to substantial improvements and help to reduce the sometimes severe shortcomings (e.g. predominance of knowledge transmission models of teaching). At the level of political decision making, at institutional (school) level and at an individual (classroom/teacher) level these scientific knowledge bases may contribute to more adequate decisions and better outcomes.[13]

At this point it may be asked:

(i) Why are research-based knowledge and scientifically validated practices used only to a limited extent by institutions of TE and teachers?
(ii) Why are most institutions of ITE reluctant to contribute pro-actively to an increase of the scientific knowledge bases of teaching and TE?
(iii) How can politicians responsible for education in Member States of the European Union be made aware of the necessity for state of the art knowledge in teaching/learning and TE when advocating reform and improvement?[14]

Using scientific knowledge bases on teaching/learning and TE several commissions and committees have presented proposals to improve the curricula of ITE (cf. The Holmes Commission 1986, 1995; Bildungskommission NRW 1995; DGFE 1997). Considering a large body of knowledge submitted by the social sciences in general and the educational sciences in particular, Bildungskommission NRW submitted a proposal containing aims, content and methodologies for ITE programmes (embedded in an overall framework of TE). The integration into research-based knowledge of problem-oriented, research-oriented and co-operative learning processes within ITE should contribute to the development of the following professional competences of a trainee teacher. Each competence is split up into three to five subcompetences):

(i) subject-related and "didactic"
(ii) methodological (e.g. a broad repertoire of teaching/learning methodologies)
(iii) management of learning groups
(iv) diagnostic
(v) counselling
(vi) metacognitive
(vii) ability to deal with (new) media
(viii) co-operative skills

This coherent set of professional competences may form the basis for the development of ITE curricula and replace the rationales of common sense based curricula.[15] As regards the clinical component of ITE, much knowledge on its effective organization has been acquired. The concepts of action research or of reflective practice provide input for more effective ITE. Similar concepts apply to teaching/learning strategies. Knowledge about the establishment of "powerful learning environments" in ITE is available, but used only to a limited extent.[16]

More research on teaching and ITE is indispensable to increase the scientific bases of teaching and ITE both in quantity and quality

At the meeting of the Standing Conference of Ministers of Education of the Council of the European Union the Swedish educational scientist U. Lundgren (1987) said: *"The amount given to research in education compared to the costs of education as a whole is minimal. If this fact is related to the demands on education the situation may be characterized as absurd. Even though comparisons of this sort are problematic, a comparison with companies or medical welfare underlines this absurdity. A company which were to plough back as few of its resources into research and development would not survive for long"*. This statement explicitely refers to one of the basic problems of education and TE: high expectations expressed, but a restricted commitment to fund research and development indispensable to improve them – a "knowledge driven society" without sufficiently developed scientifically based knowledge?

Proposing that more research is needed may sound popular, but not necessarily creative. As regards ITE the following aspects seem to be of the highest relevance:

(i) ITE has to incorporate a clear (educational) research component into its curricula
(ii) It seems to be indispensable that institutions of TE develop a clear commitment to (educational) research
(iii) Prospective teachers should be provided with curricula and learning situations which give ample opportunity to them to become competent both in understanding educational research and in transforming it into pedagogical professionality
(iv) Prospective teachers should be given the opportunity to become "critical action researchers" (cf. Elliott 1998)
(v)Teacher educators must become (educational) researchers themselves[17]
(vi) Finally, living in times of ambiguity and contradiction, it may be asked which types of research identities might be adequate for (teacher) education ? (cf. Elliott 1998)

DF conceived as an integrative transformation science might have the potential to become the main science of/for the teaching profession

Before discussing the concept of DF as an integrative transformation science some additional arguments will be presented in support of the necessity to conceive DF as a science of/for the teaching profession.

Arguments in support of DF as an integrative transformation science

(1) One of the main leitmotifs in improving TE and education at school during the past thirty years has been the "professionalization" of teaching and TE. In adopting an approach of pedagogical professionality (cf. Combe, Helsper 1996) professional actions may be conceived of as cogent and justifiable transformations of scientifically based knowledge and practice in education, teaching and learning to particular cases by specially trained education staff considering the interests of the clients (e.g. students) involved. Both as prerequisite and consequence scientifically based knowledge and practice in education, teaching, studying and learning must exist.

(2) For the teaching profession it has remained debatable, which science(-s) might form its scientific knowledge base(-s). As regards education at (lower and upper) secondary level of the school system in most of the Member States of the European Union prospective teachers receive most of their training in, frequently two, academic disciplines, while preparation for the main tasks of teachers (educating – providing teaching-studying-learning environments) is perceived as of minor importance. In most countries trainee teachers do not graduate in education (or educational sciences) but in other academic subjects. This fact may have a

tremendous impact on the development of the professional identities of trainee teachers. In addition to the basic problems of rather reluctant education policy decision-making behaviour, several other problems of integrating theories of teaching and learning, and theories of TE, may be a consequence of this.

(3) Recently syllabuses as well as (the national) curricula of most of the Member States of the European Union may be evaluated as "common sense-based" (explainable in historical terms) collection code syllabi/curricula not always compatible with changed/rapidly changing tasks and expectations of society (cf. European Commission 1995) or the progress of scientific disciplines or changed patterns of knowledge production. Substantial reforms or restructurings of syllabuses and (national) curricula are still pending in most European Union Member States. Coherent curriculum research may be indispensable. The orientation of existing syllabuses and (national) curricula in some academic disciplines is somewhat problematic in at least four ways:

(i) The fragmentation of syllabuses/curricula into (school) subjects corresponding to certain academic disciplines may be seen as a debatable pattern of organization of teaching/learning closely related to (although several years out of date and no longer applicable) industrial modes of production (cf. Taylorismus vs. Post-Fordismus).

(ii) The question still remains, why certain academic disciplines have been incorporated into the syllabuses/national curricula and others have been rejected or have recently been neglected (e.g. communication sciences).

(iii) A (sometimes hidden) assumption may be detected, in which correspondence of a particular academic discipline with a particular school subject is stated. While Seel (1999) has analysed the inappropriateness of this assumption for the (school) subject geography, Buchberger (1999) has submitted the argument that mother tongue teaching/learning as a subject at school has to integrate knowledge produced independently in more than 14 different academic disciplines. However, in attempts to establish a (school) subject "media culture competence" in the German education system Schoenert (1998) refers to 23 different academic disciplines, while focussing on the philological tradition of the academic discipline "Germanistik".

(iv) The difference between the aims and tasks of (many) academic disciplines (production of explanatory knowledge structured systematically in a propositional format) on the one hand and the aims of teaching/learning on the other is often neglected, leading to severe problems.

(4) Closely related to what has been said above, ITE and its programmes are split up into different and in many cases unrelated (academic) disciplines. These academic disciplines focus on the development of scientific knowledge/explanatory models and theories, and do not consider the phenomenon of teaching/studying/learning particular topics. The transformation of scientific knowledge structured propositionally and systematically into (human) knowledge structures following different patterns of organization (e.g. holistically, episodically) may frequently not be seen as an aim of academic disciplines and their fields of knowledge production. Additionally, a number of academic disciplines oriented on a philological tradition seem to devaluate the relevance of scientifically validated practices and show only limited interest in developing them, which may be perceived as problematic when it comes to teaching/studying/learning phenomena analysed by these academic disciplines.

(5) Teaching, studying and learning may be defined as the central content of a science of/for the teaching profession. Teaching, studying and learning always:

- take place in certain contexts/environments (e.g. macro-systems, meso-systems, particular school, micro-system learning environment and learning situations)
- have to be seen primarily as intentional actions of the actors involved
- are directed towards aims and objectives

- have substance/content
- may be supported by different media (e.g. teachers, teaching/learning aids)

The focus is on the studying/learning processes of the student who has to be provided with learning situations appropriate for him or her to develop/construct his/her structures of meaning, knowledge and action. Supporting the construction of meaning on the one hand and on the other transmitting systematically defined and structured propositions are rather different in nature.

(6) In a number of European cultural contexts Fachdidaktik(-en) in/of various fields could establish themselves as academic disciplines and have sometimes made remarkable progress. Various Fachdidaktiken have recently provided scientifically based knowledge and practices for teachers to establish learning situations in their respective fields. In many cases a tendency to isolate particular Fachdidaktiken from closely related ones, as well as a certain lack of integration may be observed – the individual learner might get lost, while expectations of a particular Fachdidaktik related to an academic discipline and its structures might become predominant. Similar criticism may apply to a holistic development of an individual. Are Fachdidaktiken able to define criteria for justifiable aims of Bildung/education and, if so, which criteria may be adopted by Fachdidaktiken to relate defined subject-specific aims to more general and holistic aims of Bildung/education? The frequently used justification of particular Fachdidaktiken, that they had to provide scientifically validated knowledge for different school subjects as defined by education politicians in (national) syllabi/curricula, could well give an impression of superficiality.[18]

(7) The explosion of scientific knowledge and the process of fragmenting knowledge may be seen in close relationship to increasing illiteracy – even of highly educated individuals – in an increasing number of content areas. Procedures of knowledge transformation seem to become indispensable – another case for DF as an integrative transformation science of/for the teaching profession?

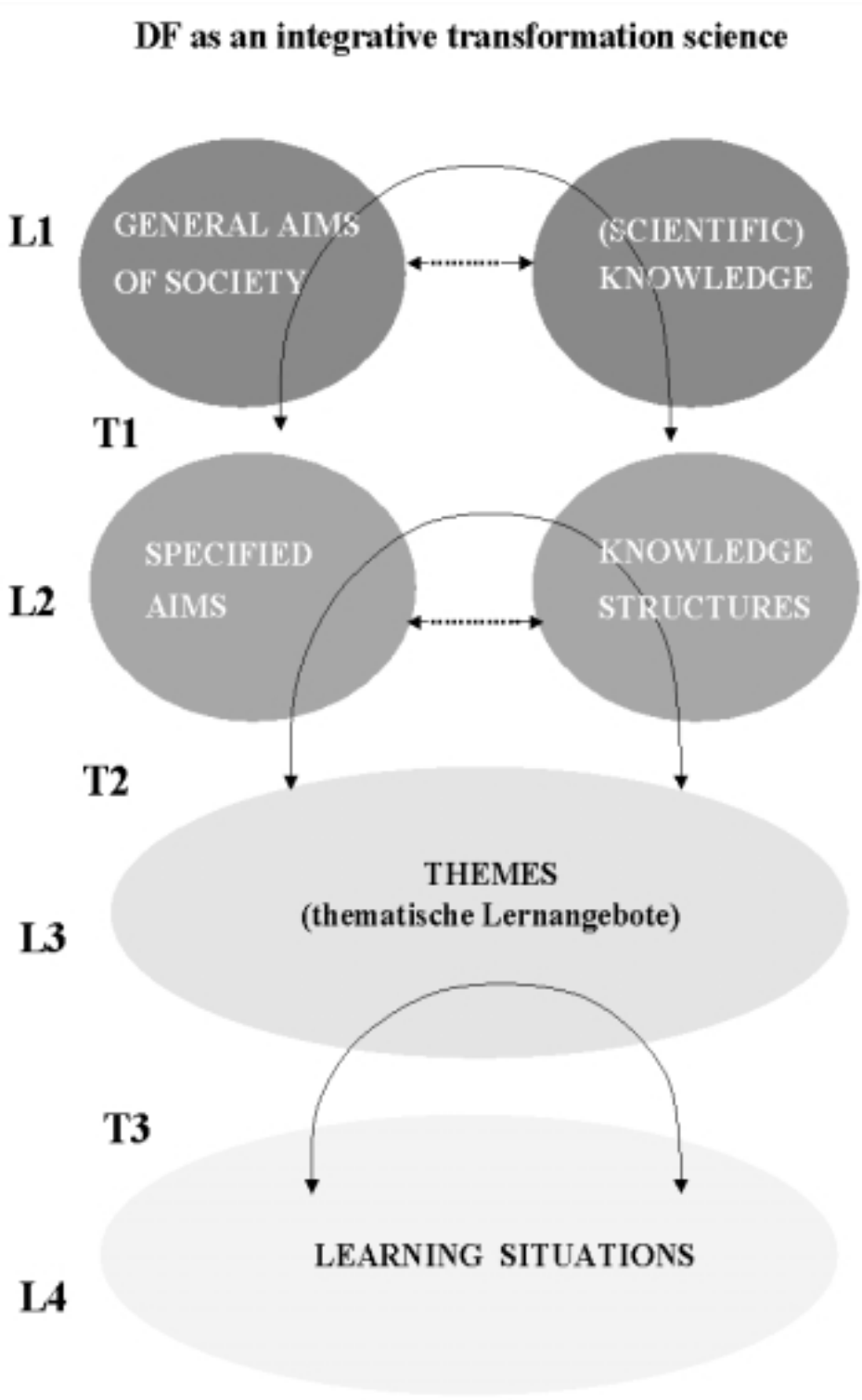
(8) The production or design of scientifically validated practices and educational software may be seen as a rather neglected field of Didaktik as well as Fachdidaktik. Designing educational software calls for co-operation in collaborative problem-solving groups composed of experts in a number of different fields (e.g. Didaktik/Fachdidaktik, linguistics, communication sciences, telematics). In most countries of the European Union DF did not really cultivate the task of producing educational software and has given free rein to marketisation in this field, with obvious outcomes. It will be suggested that DF as an integrative transformation process should deal with the production/design of scientifically validated practices and educational software. Maybe it could then reduce the technological deficits obvious in the field of teaching, studying and learning hidden behind fig leaf formulae (e.g. "theory-practice-conflict").[19]

(9) Teaching, studying and learning in places called schools may be defined as the central content areas of DF, but the relative relevance of teaching and learning in places called schools in relation to other sources of learning (e.g. home, peers, community, mass media and the net) has to be considered in DF as an integrative transformation science.

DF as an integrative transformation science

Against this background a (preliminary) structural model of DF as an integrative transformation science will be discussed as follows:

(a) The model of DF as an integrative transformation science consists of 4 different levels linked together by three different transformation processes.



(b) At a first level we differentiate between "general aims of society" and "(scientific) knowledge" produced by the many different academic disciplines. The category "general aims of society" may be conceived as general (and, in particular societies, to a large extent collectively shared) patterns of interpreting phenomena of life and the world manifested in not very precisely defined (general) aims (gesellschaftliches Deutungswissen einschliesslich unspezifizierter Absichten/ Rahmenzielstellungen). The category "(scientific) knowledge" refers to the huge amount of knowledge (and technologies) produced by the sciences.

(c) "General aims of society" and "(scientific) knowledge" are either too unspecified or too extensive to be relevant to teaching, studying and learning. Both have to be transformed for teaching, studying and learning (transformation 1). General (and sometimes contradicting) aims of society

have to be transformed into more specified aims for teaching and learning (transformation 1). Concepts such as Bildung may have important roles to play in this transformation process (cf. Klafki 1992 and his concept of Allgemeinbildung oriented on key-problems of society). Propositionally formulated and systematically structured knowledge of particular academic disciplines has to be transformed into knowledge structures. Both transformations within the first transformation process may not be seen independently. While many interactions exist between "general aims of society" and "(scientific) knowledge" and its production, dialogues between representatives of society (democratic authorities) and the DF research community may be seen as imperative to the transformation necessary. As regards the transformation of "(scientific) knowledge" into knowledge structures, the dialogue between representatives of the different academic disciplines and the DF research community may be seen as a necessary condition.

(d) "Specified aims" and "knowledge structures" may be seen then as the second level of DF. They form a potential pool of aims and knowledge structures to become the subjects of teaching, studying and learning.

(e) In a second transformation process specified aims and knowledge structures have to be integrated to possible "thematic units" or "themes" (thematische Lernangebote) for teaching, studying and learning. Considering
   - on the one hand the many aims possible and the huge amount of knowledge structures available and
   - on the other hand the limited resources, human information processing capacity and time available

   transformations of type 2 are indispensable. Transformation 2 has to result in a justifiable pool of "themes" or thematic units.

(f) "Thematic units" or "themes" conceived as coherent sets of aims and content may be seen as level 3 of DF.

(g) In a third transformation process "thematic units" are transformed into concrete learning situations (level 4). Learning situations may be characterized by the following components:
   - context,
   - actors (e.g. teachers, learners), their characteristics and actions,
   - aims and objectives,
   - content/substance,
   - teaching/studying/learning strategies, and
   - media.

(h) Having categorized "general aims of society" and "(scientific) knowledge" at the first level, and "learning situations" at the fourth does not imply superiority of the first or less relevance to "learning situations". The model of DF as integrative transformation science intends to outline the integrated nature of the phenomenon under discussion which cannot be reduced to one or the other category/level or transformation.

The model of DF outlined might have enormous impact on restructuring TE (e.g. focus on teaching, studying and learning instead of academic disciplines), the organization of teaching and learning in schools (e.g focus on learning situations and thematic units/problem areas instead of subject-matter structures) and the teaching profession (e.g. solid scientifically validated knowledge and practices which could contribute to empowerment and reduction of dependence on external and political control as well as on non-teaching related academic disciplines). Additionally, DF conceived as an integrative transformation science could open up new opportunities to tackle another often neglected problem of teaching and learning. It could provide a framework for the production of empirically validated teaching and learning technology/Veraenderungswissen (e.g. netbased learning environments and software) comparable to treatments/medicines in the medical sciences.

Producing and adopting scientific knowledge bases to improve teaching/learning and ITE calls for co-operative problem-solving processes of all the actors involved

Popkewitz (1993) has cogently characterized TE as a "social arena" with many actors with conflicting interests and different power. Many resources are wasted because of "power games" of different lobbies and interest groups and which accounts for inappropriate improvement (cf., for the situation in Germany, Oelkers 1998a, b). Adopting principles of general systems theory (cf. Luhmann 1984) it may be proposed that systems open to their environment produce more appropriate results, whilst the opposite applies to more closed systems. This suggests that systems should be more aware of their environments and their (inner) capacity for (self-) renewal stimulated. One major consequence is the need for co-operative problem-solving processes from all those involved in the improvement of a system – be it a TE institution or a particular school. These will mainly be education politicians, school administrators, (prospective) teachers and the scientific community including teacher educators, educational scientists and scientists from many fields of inquiry (not necessarily restricted to the traditional sciences, but corresponding to content areas of the recent curricula of schools). One of the main findings of the evaluation of TE reform in the United States indicates that co-operative problem-solving processes of all actors involved has to be seen as a necessary condition for progress (cf. Fullan *et al.* 1998).

Additionally, problems to be solved cannot be tackled adequately by one person, a small team of specialists in a particular field of inquiry or a particular research tradition alone. Interdisciplinarity and co-operation have become indispensable. Considering the limits of our information processing capacity this again calls for co-operative problem-solving groups. It seems necessary that individualistic and disciplinary-bound cultures of research have to be replaced by co-operative ones (cf. Shulman 1987 and his remarks on searching for missing links in research on teaching and learning). But many patterns of organization at universities and corresponding cultures of research may be seen as severe obstacles. If individuals avoid co-operation, neglect integration centered around the teaching/studying/learning process and do not pro-actively make use of the effects of synergy as well as existing (and developing) scientific knowledge bases they may easily find themselves – or remain – in the position of the famous German Baron Muenchhausen, who tried to pull himself out of a swamp by his tuft– without success.

II
Developing DF as a science of the teaching profession

Systems and programmes of TE in the Member States of the European Union may be characterized by some commonality and a rich variety of difference (cf. Buchberger 1994). Within these systems the role of scientific knowledge in teaching and learning is interpreted very differently and may range from a negative approach and ignorance to high esteem and highly developed academic cultures. This may be seen in close relationship to the state of development of a scientific knowledge base for teaching and learning. While some systems of TE have still remained in a pre-scientific state and focus on dogmatic, not to say normative, methodologies, others have been able to make use of scientific knowledge and have developed research cultures. With good reason it can be suggested that some basic elements of a science of/for the teaching profession has been developed which may form a valuable base for the further development of a science of/for the teaching profession (e.g. the research and development cultures at Finnish departments of TE at university faculties of education; Buchberger *et al.* 1994). The same applies to research and development centres for particular fields of teaching and learning (e.g. Institut fuer die Didaktik der Mathematik, Bielefeld/ Germany) established in the seventies.

Developing a science of/for the teaching profession has to consider insights developed by innovation theory and has to be conceived as a change of a social (academic) system. In addition to what has

already been said on restructuring the curricula of ITE and schools, the following proposals are made to establish and to develop DF as a science of the teaching profession:

(i) If institutions of TE make use of Wissenschaftsdidaktik and transform principles developed there to their own curricula and teaching/learning situations, some progress may be expected.
(ii) Institutions of TE should be encouraged to establish co-operative problem-solving groups consisting of staff/researchers of different academic specializations and backgrounds. They should be encouraged to research on concrete problems/projects in an integrated manner.
(iii) In institutional terms faculties of education seem to have considerable potential to provide appropriate research and development cultures.
(iv) Centres of excellence might be established doing research and development in selected teaching/learning areas (e.g. The Centre for Multimedia Education at the Department of Teacher Education at Helsinki University, Tella 1998).
(v) If statements in education policy documents (e.g. European Commission 1995) are to be more than lip-service, then coherent action at European Union level seems to be indispensable. We suggest the establishment of an all-European task force on teaching and learning dealing pro-actively and constructively with the problem areas mentioned in this paper. A special chapter on this issue might be included into the targeted socio-economic research programme (TSER) of the European Commission to provide the necessary resources.

Let us conclude with a modified statement of the Austrian poet E. Fried: *"Those who wish that teacher education and the teaching profession remain as they are, do not wish that they remain"*.

Notes

1. In the first two paragraphs commenting on major education and training policy documents we have frequently used the term "perceived". This reflects the fact that (education) policy documents make use of the language of policy and aim at establishing certain patterns of discourse and thinking closely linked to the interests of particular political groups (e.g. neo-liberals). From this perspective reported policy documents and the issues contained in them may be seen as subjective interpretations and perceptions, not as "given facts" or "inescapable trends" (cf. Elliott 1998 and his comments on this phenomenon in dealing with education research identities).
2. "Quality" has become a slogan/formula with ambiguous meanings since the late eighties and has increasingly begun to dominate the education discourse (cf. Buchberger, Byrne 1995). Recently, it may be seen as one of the key concepts of the so-called New Public Management (NPM) aiming at a substantial restructuring of organizational and administrative patterns of education and training establishments (cf. Forneck 1997 and his critical comments on discrepancies between aims of education and aims of NPM).
3. The concept of "professionalization" has very different meanings in different European cultural contexts (cf. the issue on the theme of professionalization in the European Journal of Teacher Education, 2–3/1994, Bourdoncle 1994) which may be seen as a source of much misunderstanding. In addition to sociological interpretations of professionalization this umbrella concept can be interpreted as "paedagogische Professionalitaet" (pedagogical professionality) (cf. Combe, Helsper 1996, Wagner 1998).
4. Kuenzli (1998) has recently adressed the problem of the development of a science for/of the teaching profession (Didaktik) and has submitted arguments to consider it as a "popular science" ("propaedeutische Populaerwissenschaft").
5. Cf. the contributions of German, Scandinavian, English and American educationists in colloquia on "Didaktik and/or Curriculum" (33. Beiheft der Zeitschrift fuer Paedagogik 1995, Gundem, Hopman 1998).
6. Kron (1994), Seel (1999) or Kansanen and Meri (1999) present more differentiated categorizations of the field of Didaktik by adopting criteria such as general, specific, content/subject matter or age.
7. The "T.J. Hooper"-decision of the US Supreme Court had substantial impact on special needs education in the USA. By analogy parents received the legal right for the best education provision for their disadvantaged children. It would be a fascinating case were parents in the European Union to sue providers of (compulsory) education because of suboptimal education provision (i.e. not following the state of the art knowledge on teaching/learning and sometimes perhaps with problems in relation to the Declaration of Human Rights) in various cultural contexts of the European Union.
8. Lanier and Little (1986) have described the many problems of curricula of ITE in the United States; Oelkers (1996,

1997) has submitted cogent analyses on the problematic state of ITE curricula in German speaking contexts.

9. Studies on the effectiveness and efficiency of ITE are still lacking. Recently a substantial study in Switzerland has tried to provide answers to this problem (cf. Oser 1997). Additionally, it is frequently mentioned that effects of ITE "are washed out" when young teachers enter the teaching profession (cf. Vonk 1994); that a "culture of induction" has not fully been developed and that "learning/professional development" at the working place, school, and its cultivation may be seen as blind spots of TE (Buchberger 1994). These facts may be brought into close relation to a suboptimal use of (especially human) resources.
10. As regards syllabi Weniger has stated that syllabi/curricula have to be seen as the outcome of struggles between different political and social groups. Oelkers (1996) has analysed the influence of the (nation) state and governments on the curricula of ITE in Germany and has spoken of the influence of "Staatspaedagogik".
11. Oelkers (1996) has analysed the rather ambivalent relationship between the development process of educational sciences and TE in Germany. Reynolds 1998 has claimed the non-existence of educational sciences in England (while submitting at the same time a rather narrowly conceived conception of it, focussing on research on effectiveness of teaching and learning).
12. Cf. the model of ITE oriented on professional standards (Oser 1997) or the descriptions of some reform projects of TE in Germany (Bayer *et al.* 1997).
13. In a rather neutral form we have used the notions "making use of" scientific knowledge and that it might "contribute to" more adequate solutions. This reflects a position which acknowledges (i) the relevance of different types of knowledge (e.g. propositional knowledge, "tacit" knowledge, action-relevant knowledge), and (ii) takes into consideration social as well as affective components. This also reflects uncertainties in the relationships between different types of knowledge. There is much evidence that simple application models (of propositional knowledge to concrete problems) and knowledge transfer models seem to be inappropriate. More research on models of knowledge tranformation seems to be necessary (cf. Kolbe 1997, Radtke 1996).
14. Cf., for the situation in England, several articles in Mc Bride (1996), or for a more international perspective, contributions in Wideen and Grimmett (1995).
15. While the model of Bildungskommission NRW reflects a challenging concept for TE reform as regards aims, content and methodologies, organizational as well as institutional issues are adressed in a rather conservative way and might be interpreted as avoidance behavior of reformers considering power structures in the "social arena" of TE (cf. Buchberger 1998a).
16. Stern and Huber (1997) have submitted a comprehensive report on active learning in eight OECD member states. An all-European consortium is working on a Socrates curriculum development project (ALERT) making use of active learning methodologies in ITE. This project combines the potential of cognitive psychology, learning ecology, different European reform pedagogies, and net-based learning (cf. F. Buchberger 1999).
17. The introduction of ITE into the higher education sector of the education system in German-speaking Switzerland has brought about heated discussions on the role of research in ITE. While these discussions have led – intellectually – to clarifications on the role of research in ITE, (possible) solutions again seem to reflect more power structures in a social arena than rational argument (cf. Grossenbacher *et al.* 1998).
18. The Konferenz der Vorsitzenden Fachdidaktischer Fachgesellschaften in Germany has quite severely criticized efforts to establish more integrated models focussing on domain-specific didactics (Bereichsdidaktiken) instead of subject-related didactics in research and TE (e.g. Bereichsdidaktiken as "super sciences"). Unfortunately, rational argument has not been provided to support Bereichdidaktiken – a case of struggles in the social arena of TE?
19. In most education circles in German speaking countries "technology" or "technological theory" are perceived as "nasty words", and there are frequent doubts about whether educational technology might even be possible. A comparison with health/medicine and "standard treatments" of medicine such as antibiotics might bring about new definitions of the problem area of teaching/studying/learning.

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Didaktik as the professional science of teachers

Abstract

In the 1980s and 1990s the reform of schools under aspects of the individualization of teaching, the profiling of each school within the system and the democratization of decision processes at school level required new qualities and competencies of the teaching profession. The process of professionalization is given support by making high demands on teachers to offer, and be responsible for, a client-centered pedagogical service.

The further development of Didaktik as the science of the profession of teachers proves to be important and a connection with the German 'bildungstheoretische Didaktik' seems to be promising. The new 'concept' of Didaktik has to be understood in a comprehensive way; in addition to a theory of teaching it also includes a theory of Bildung and a theory of school as an educational institution. As a theory of teaching Didaktik deals with concerns of contents, procedures and time. Teachers shall be enabled to carry out didactical analysis of the selected teaching contents within the framework of teaching plans and to develop appropriate methodological concepts.

To ensure the general objectives of schools (to create and support Bildung as the capability to judge responsibly, make decisions and act within the challenges of society), it is necessary to counteract the danger of a subject-oriented splitting up of teaching and learning in school and to develop new problem-related networks (dealing with "key-problems", project teaching etc.). Subject-matter didactics have to be understood as limited focussing within the framework of general didactics.

Outline of a reviving school

The attempts at school reform during the 1980s and 1990s are the consequences of a modified awareness in society. In a value-pluralistic society the importance of the individual increases. Self-realization and self-determination are given priority. Societal institutions are confronted with increasing demands for participation by their members. Individualization and democratization become defining criteria of change even for schools.

A characteristic feature of the traditional school is hierarchy and uniformity. Curricula define the targets, contents and ways of teaching and standardize school qualifications and connected certificates. The teacher is under a legal obligation to observe these rules; his/her independent responsibility is very limited.

Differentiation and individualization with regard to instruction, support and assessment of the individual student are current demands, as is the individual freedom for schools to support their own development and focus of interest. They influence teacher activity: A teacher's identity is

modified from being an executor of official orders to being the responsible organizer/designer of a client-centred pedagogical service within the framework of school.

These two contradictory positions – differing in individual countries – see themselves as justified by the specific self-image of school administrations and their legal basis as well as by culture-specific developments of scientific disciplines relevant and important for school and teaching.

With regard to the intensity of the obligation put on teachers by syllabi and curricula, Stephan Hopmann (1998) suggested the following categorization: the philanthropic model, the licence model, the *examen artium* model and the assessment model. School systems that use the licence model (framework syllabi with space for independent and self-determined teacher activity), are able to adapt more easily to new expectations of schools.

Also the tradition of scientific disciplines that are responsible for the theory of school and teaching, creates different conditions for the transition to the 'new school' and its theoretical basis outlined above. In the German-speaking countries the concept of a 'bildungstheoretische Didaktik' was developed in the 1920s and 1930s (Weniger). Its basis was the 'geisteswissenschaftliche Pädagogik' (Dilthey, Nohl) which, by regarding educational goals dependent on epoch and society, tried to overcome the normative character of pedagogy. Herbart and his contemporaries and successors viewed the aim of education as determined by ethics. In the so-called 'pädagogischen Verhältnis' (pedagogical relationship), the core of all educational events, the educator is assigned the critical evaluation of educational aims and procedures expected by society with regard to the presence and future of the student. Criteria for evaluation and decision are developed through the scientific analysis of the 'pädagogischen Verhältnis' (pedagogical relationship).

This fact demanded a relative pedagogical autonomy for school and teachers. The state was expected to decree a framework syllabus to balance the interests between representatives of society and representatives of political power, which leaves the selection and emphasis of specific teaching content to the teacher and makes him/her responsible for independently selecting appropriate teaching methods.

In the 1960s and 1970s this pedagogical and didactical tradition of 'geisteswissenschaftliche Pädagogik' became less influential in the German-speaking area and the Anglo-American concept of a teaching theory was imported. Its characteristics are the definition of teaching targets as competencies and qualifications of the student by legitimized authorities (state, regional authorities, school boards) and the optimizing of learning processes by using theories of learning. The theory of teaching is part of educational psychology (cf. Gage and Berliner 1997). Didaktik as the scientific basis and action theory of teaching does not exist; the word didactics refers to the ability of effectively executing the regulations for teaching with regard to contents and procedures (for the situation and development in the USA, cf. Doyle and Westbury 1992).

According to Shulman, this position of a lesson-related instruction theory is too limited for a scientific basis for the professional practice of teachers. He criticizes the exclusively psychologically oriented research that neglects important components of teaching ('such as the subject matter being taught, the classroom context, the physical and psychological characteristics of the students, or the accomplishments of purposes not readily assessed on standardized tests', Shulman 1987, p.6).

If you look at his categories of the fundamentals of knowledge for a successful teacher (Shulman 1987, p.8: content knowledge – general pedagogical knowledge – curriculum knowledge – pedagogical content knowledge – knowledge of learners – knowledge of educational contexts –

knowledge of ends and values), a certain correspondence can be found with the demands on a teacher for a successful realization of the 'didactical analysis' (cf. Klafki 1963).

This requires the clarification of the following aspects regarding a selected or given teaching content: importance of the teaching contents in the presence and the future of a student; prototypical effectiveness of the teaching content (possibility of disclosure of elementary structures as a basis for transfer effects and development of fundamental experiences as a prerequisite for attitudes and values; logical dimensions of teaching contents (some aspects and their connections; levels of meaning); accessibility of teaching contents (availability in real or virtual form: up-to-date factor of topic).

It is not surprising that due to the expectations of society concerning individualization and democratization of schools, a 'renaissance of Didaktik' has been noted in German-speaking countries in the 1990s (cf. Hopmann and Künzli 1992). About 30 models of didactical theories were developed in German-speaking countries (cf. Kron 1993). This number has even increased in past years. At a conference of the 'Kommission Schulpädagogik/Didaktik der Deutschen Gesellschaft für Erziehungswissenschaft' in March 1999 six additional approaches were presented and explained. Most of the models, however, can only be regarded as hypotheses from a scientific-theoretical point of view. Many of them lack a systematic verification by empirical research. But they all have some limited relevance for the actual situation in schools, as several teachers tested these models in their lessons and reported positive individual experiences.

As a first conclusion: it seems to be necessary to modernize the discipline of the Bildungstheoretische Didaktik with regard to content and range, taking into account new results from experimental and research results (Gudmundsdottir and Grankvist 1992). It is evident, however, that such a development will be more difficult to realize on the basis of Anglo-American tradition.

Didaktik as the scientific basis of the teacher profession

The demonstrated change of quality in the work of teachers inspires the trend towards the professionalization of the teaching force in a new and important way (Shulman 1987). Independent and client-centred pedagogical and didactical practice requires scientific theory and reflective practice. Measures for the securing of success have to be changed. Control by school inspection systems, to monitor if rules are being observed, is not essential any longer, but the quality of the service has to be improved and conserved by an exchange of views with colleagues and consultations with experts. In this context the development of the professional science of teachers is the main issue. By modernizing Didaktik it can be realized. A system of concepts has to be applied that follows the tradition of Bildungstheoretische Didaktik.

Bearing in mind that achievements of school and teacher activities are committed to two aims – the interest of societal reproduction and the personal development of each individual student – one can criticize the biased orientation of the education-didactical theory towards students. The societal function of school fades. This explains, for example, the problematization of assessments according to given standards and norms as they are connected with relevant legitimation. Herbart already pointed out that public schools cannot be pedagogical institutions ('Über Erziehung unter öffentlicher Mitwirkung', 1810), as an educationally supporting, and therefore justified, assessment of students can only be oriented at the individual learning progress of the student and not at comparison with other students according to official criteria which repeatedly produces students who fail.

Despite all student orientation one has to notice, however, that a school as a learning formation, established and maintained by society, has to accomplish its reproduction function with regard to culture, economy and politics (Fend 1981). The professional teacher has to balance the experiences and demands of two proponents: students and society.

Didaktik as the professional science of teachers must not be limited to a theory of teaching. It also has to include a theory of Bildung and a theory of school.

The 'Map of the Professional Science of Teachers' shown on the next page outlines these connections.

Map of the Professional Science of Teachers

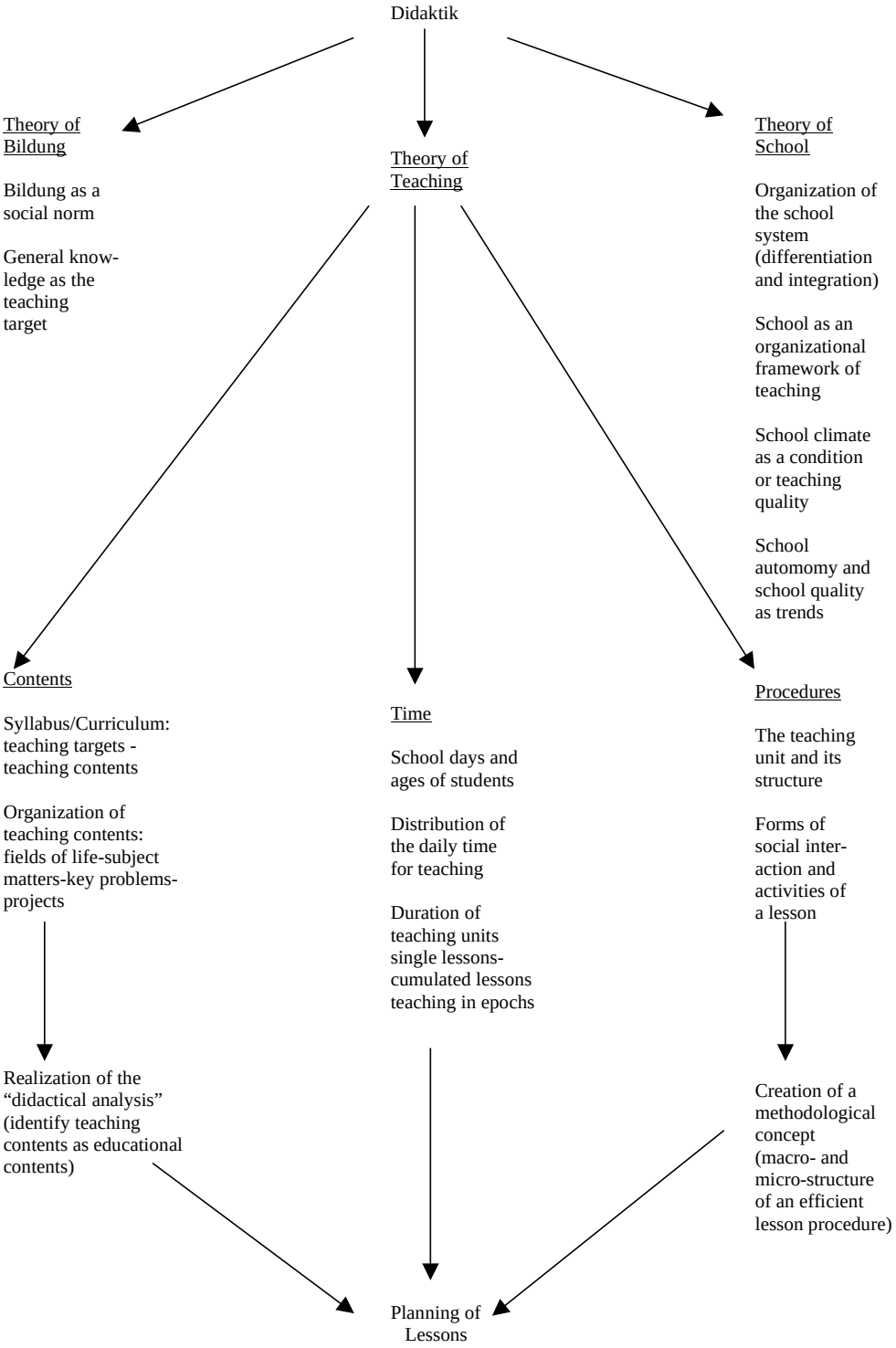

Figure 1

This extension of Didaktik beyond a restricted theory of teaching requires a few remarks.

In every society a fundamental consensus concerning the desired image of its members exists. Educational interactions are guided by this idea, they basically show a teleological structure. Education aims at Bildung. The educated (gebildete) human being is – this is at least valid for value-pluralistic and democratic societies – marked by his/her ability to judge, decide and act in the various situations of life (societal problems and challenges, personal crises and affections). This social norm is reflected in the general educational target of school and constitutes an important basis for the selection of learning contents and their arrangement within the syllabi.

Didaktik – as part of the science of education – has a critical and a constructive function for the definition of the educational targets and the construction of syllabi for schools. It analyses, clarifies and ascertains the aims acknowledged by societies and takes part in the construction and evaluation of the plan of education. Therefore its function is not normative but descriptive; it provides the professional teacher with a tool for a critical analysis of teaching targets and teaching contents. Since the 1980s the expression 'Allgemeinbildung' (basic competence) has been used more widely to describe the educational task assigned to schools. This expression indicates: the right of scholastic education for everybody, dealing with all topics relevant for life in the present and future and support of the development of all human talents (Klafki 1985, Brezinka 1998, Schulze 1990). As far as the content is concerned the necessary scale of knowledge and ability, of attitudes and standards, is defined.

School as an institutionalized and organized learning formation represents a specific framework of the teaching-learning connection. Important aspects are:

- Learning shall take place even though there is not an emergency situation
- Learning shall occur without natural, self-regulating structure
- Learning shall be possible as an individual event in a collective unit of students
- Learning shall happen for future needs, its results shall have an impact on 'real life' or at higher learning levels

Teaching includes the following tasks and services:

- Motivating
- Securing the willingness to learn
- Structuring learning processes
- Creating individual learning occasions
- Giving feedback on learning success
- Preparing learning transfer

These tasks cannot be fulfilled only by applying the theory of learning. Willingness to learn and success in learning depend on the climate of school and classrooms (Haenisch 1989 or the school ethos (Rutter *et al*. 1980).

Organizational regulations lay down whether teachers have to teach in classes with a wide or narrower range of talents and interests of students. This results in differing conditions and the necessity for differentiation and individualization when supporting and helping students in their learning process. Moreover, learning requires a specific educational framework; the external learning conditions for individual students have to be secured (motivation, concentration, cooperation etc.). One should again be reminded of Herbart: 'Erziehender Unterricht' (educating instruction) as the central core

of education is made possible by a preceding and steering guidance of the student. In the Kritisch-kommunikative Didaktik (Winkel 1986) a lesson is mainly looked at from an angle of intertwined interactions. As conflicts interfere with successful teaching, conflict management is given priority.

The theory of teaching is still the core of didaktik as the professional science of teachers. On the one hand, it deals with questions of lesson content, for example, the theoretical basis for the development of syllabi: the justification of criteria for the selection of teaching content as well as the structure of the teaching content in areas of life; subject disciplines; key problems or projects. It also provides the prerequisite for the realization of the 'didactical analysis'. In the context of the didactical analysis, possible teaching contents are evaluated from the point of view of an assumed educational efficiency (Klafki 1963).

With regard to procedures for the possibility for discovery, problem-oriented learning is of major interest. This criterion steers the development of the ideal procedure structures for a lesson but also defines the meaning of several social and action forms (lecturing, teaching conversation, group work, individual work) during the different parts of a lesson.

When planning lessons teachers make a didactical analysis of the teaching content (educational efficiency of the teaching contents). They also create a methodological concept (macro- and micro-structure of the learning/teaching process) for the lessons, taking into account the time factor (duration of a lesson, time of the day when the lesson takes place, extra-curricular time for studying).

The educational efficiency of school and instruction split up into subject matter

Nowadays, one of the characteristic features of school is a canon of discipline-oriented subject matter and teachers specialized in subject disciplines. Will subject matter didactics be the future professional science of teachers? This question cannot be answered in the affirmative

Besides subject dominated instruction there still exists the integrated instruction of the elementary school. On the one hand there is the teacher for a specific subject or a few subjects and on the other the didactical 'decathlete'; a teacher for all, or at least many, fields of learning at elementary level. The relationship between Didaktik (in a general, comprehensive understanding of the term) and subject-matter didactics has to be clarified. This is not possible without reference to the development of schools.

In the course of a long tradition, an often changing canon of subjects was developed in European schools and stages of development 'overlapped': The canon of subjects and their contents in elementary and grammar schools can only be understood when taking this development into account (Dolch 1982). Initially, the teaching-learning areas were 'Kunden' (knowledge for actions and decisions essential for life: geography/Erdkunde, biology/Naturkunde, natural history/ Naturgeschichte, history); and skills (proficiencies in communication, presentation and design: languages, arithmetic, crafts). In the 17th and 18th centuries they were guided by societal-political expectations (contribution of schools to the education of useful and contented subordinates).

In the course of the development of modern natural, cultural and social sciences in the 18th and 19th centuries, there was an orientation of the canon towards scientific disciplines, due to the implications of scientific research and development in all areas of society. This was also due to the special interest of sciences in the role of schools in preparing students for studies at university level. The canon did not prove to be 'historisch zwingend noch systematisch homogen oder gar universal

and damit überzeitlich gültig' (Kramp 1970). Some scientific disciplines are not represented in the canon of subjects of elementary and grammar schools: medicine, law, astronomy, economics etc.; others are covered by the specific content of subjects whose names point at other scientific disciplines (e.g. geography with topics from geology, meteorology, hydrology etc.). Subject matter often relates to several sciences.

Subject matter and sciences differ in their targets. Sciences aim at a complete and methodologically appropriate comprehension (by research) and a systematic order of all facts in a clearly defined field. Subject matter aims to offer opportunities to make experiences relevant for life. It is legitimized by its contribution to an improvement of judging, deciding and acting within societal and personal challenges. It is explained and justified by its contribution to the Bildung of the human being (Seel 1983).

There has to be a difference between scientific orientation towards learning in schools (scientifically approved teaching contents, the provisional nature of findings) and the scientific preparation (for university) that has to be pursued as a special target of schools of advanced secondary level besides their educational task. Scientific preparation, e.g. the introduction to scientific methods and systems, can only take place in a few areas selected by the student as a preparation for scientific studies at university. This is demonstrated by the function of the sixth form of the English school system.

Without going into any detail, it should be noted that when extending the canon in Austria, due to new societal needs and expectations, the names of the sciences referred to were not chosen but the traditional names 'Kunde' (knowledge): geography and 'Wirtschaftskunde' (economics), history and 'Sozialkunde' (social studies), biology and 'Umweltkunde' (environmental studies).

This point can be misunderstood in two ways (Aselmeier 1985): first, by a reduction to the scientific-cognitive dimension (subject matter as a diminutive of scientific disciplines) but also by the isolation of subject matter and its subject matter didactics within the canon. The latter leads to a current discussion: that life is not "divided into subject matter". The overcoming of societal problems and personal crises requires more complex processing involving multiple dimensions. A student or graduate cannot be expected to succeed in the integration of subject-matters when faced with problems of real life.

A third phase of syllabus-development tries to take these findings into account: measures for stimulation of subject-exceeding, subject-crossing teaching. To give an example: in Austrian syllabi this is realized by 'teaching principles' in addition to the canon; political education and peace education, media education, health education, sex education etc. Within the continuing reform of the syllabi for schools at lower secondary level, traditional subject matters are integrated into comprehensive areas of learning.

Hentig (1969) developed a plan for restructuring teaching contents according to the dimensions of life in our society: life in a changing world; in a world of a division of labour (a more specialized world); in a world rationalized by science and technology; in a job between theory and practice; in the abundance of means and the variety of targets; in a secularized world; with one's body; with other generations; with the one and only world.

Klafki (1985, 1998) indicates that educationally efficient instruction has to be directed at the "central problems of common presence and predictable future". He suggests dealing with 'key-problems' in addition to the traditional subject-related instruction and recommends including: the questions of peace, environment, social injustice, unequal distribution of wealth, employment and unemployment,

freedom and participation, the relation between the generations, human sexuality and the relationship of men and women, interaction with those who are handicapped and with foreigners, defining national identity with regard to universal responsibility, handling of mass media etc.

On the other hand, the introduction of young people into a world which is increasingly dominated by the sciences and their transformation into the life of society (production, traffic, nutrition, health, communication, administration etc.) is not possible without some differentiation in the form of subject matter. New, problem-related, networks have to be looked for in Didaktik because it is wrong to expect that "durch Addition dergestalt (d. h. fachlich gegliedert) vermittelter Erkenntnisse, Kenntnisse und Fähigkeiten werden sich irgendwie Wirklichkeits-und Selbstverständnis einstellen" (Klafki 1995b, p.38; for the current discussion; on a reform of the canon cf. Giesecke 1997, Hentig 1985, Wilhelm 1985, Tenorth 1994). At the level of lesson procedures an important contribution is expected from project instruction to cross borders of subject matter.

As a consequence of the discussion: between general didactics and subject-matter didactics there exists a dynamic relationship that has to undergo continuous evaluation and reassessment. Klafki (1994) indicates this in his thesis of the relationship between 'Allgemeiner Didaktik and Fachdidaktik' when he understands subject-matter didactics as a specific form of specialization in the field of general didactics beside other forms (didactics of school levels, didactics of school types).

In teacher education this suggests finding a way from general didactics (teaching in school) to a specialization in subject-matter didactics (teaching of a subject within the context of school). If, however, access to teacher education is only looked for after having specialized in content (priority of studies in relevant scientific disciplines), a student- and a lesson-oriented approach to subject-matter didactics will recommend and provide the extension of Didaktik in the comprehensive understanding suggested by this chapter.

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Reflection as a bridging concept between normative and descriptive approaches to didactics

Abstract

From a theoretical point of view, it is widely recognised that didactics has both normative and descriptive aspects. The normative approach seeks principles and procedures to decide about aims, subject matter and teaching-learning methods in education, mostly for the purpose of educational planning. The descriptive aspect of didactics focuses upon the teaching-learning reality, its contexts and the students' learning experiences, in order to understand the educational process. Traditionally and philosophically, these two areas are considered as clearly separated, and there are no straightforward ways from the descriptive ("is") to the normative ("should") approaches to education.

In educational practice, these two parts of didactics are intertwined. This paper will present a comprehensive, analytical model, mapping the main components that make up the life of classrooms. In the perspective of classroom and educational development, this model may serve as a tool to understand and to some extent explain the relationships between factors influencing classroom life. The secrets of change in individual teachers' practices are, however, to be found in how they connect and combine normative ideas and descriptive information. Thus, reflection becomes a core concept in the attempt to bridge the two separate worlds of didactics. This paper investigates what kinds of norms and ideals on the one hand, and descriptive and analytical information on the other, may constitute teachers' reflections, and how this "amalgam" is used in practice. Some considerations are also given to the implications for teacher education.

Introduction: On the relationship between general didactics and subject didactics

In many countries there is an increasing trend to focus on subject didactics, and how this discipline can be developed as a central part of teacher education in Europe. Subject didactics, as opposed to general didactics, is directed towards particular school subjects, and embraces a wide variety of theories and research approaches. In my experience, there exist as many varieties of subject didactics as there are subjects in schools. Traditionally, students in teacher education face a range of different theories and perspectives according to their subject interests. A theory about teaching and learning mathematics can be very different from a theory about social or natural sciences. After all, learning the multiplication table is quite different from learning to understand the ecological balance in nature and how it is disturbed by environmental pollution. Subject didactics is often considered as a very practical and "useful" part of teacher education, providing students with theories, perspectives, and advice closely related to the teaching situation. General didactics, therefore, has a clear limitation concerning *specific* teaching and learning problems in different subjects.

General didactics, on the other hand, is aiming at the construction of concepts and theories that can be applied to most kinds of teaching, targeting all teachers and prospective teachers, without regard

to their subject specialisation. The relationship between subject didactics and general didactics is to a high degree a question of practicality and instrumentality of theories. The meaning of "usefulness" is, however, more than giving practical prescriptions or guidance for specific subjects. Even a highly abstract theory can be very useful if it helps to ask good questions, whether it is linked to the context of specific subjects or not. In addition, educational systems have many functions that are not subject specific. A mathematics teacher and a science teacher are both on the same train towards a common goal, and their journey goes through the same landscape. All teachers, regardless of subject specialisation, must have an idea about their joint adventure and their collective tasks.

Thus, all teachers have something to learn from general didactics. There is no contradiction between general didactics and subject didactics, and there is no hierarchical relationship between them. It is more like a relation between figure and ground, it depends where focus is directed. The problems I want to pay attention to, are meant to be a backdrop for planning, analysing and evaluation of all kinds of teaching and learning processes, and I will focus upon problems that no subject-related theory can escape from.

Normative and analytic-descriptive didactics

For a long time there has been a discussion about what didactics *is*, what its object of study should be, and what function it should have. This discussion has partly been international, partly it has had a different character from country to country. It has mainly been limited to Central Europe and the Nordic countries. It would take us too far to recapitulate this debate here, suffice it to refer to other writers (Engelsen 1990, Kansanen 1993, 1999). Nevertheless, a few comments on the situation in Norway and Sweden could be of some interest.

German didactics is known to have a clear normative character, aiming at general principles on how to select content and how to organise teaching and learning. Kansanen (1999) has an important point when he says that the key to understanding German didactics is in its roots in German philosophical idealism in the 18th and 19th centuries. At the core of educational thinking is the idea of the educational potential of certain kinds of subject matter. Consequently, *content* becomes a central category in didactical theory.

The German tradition of didactics has been well known in Norway and Denmark during the 20th century. Since the 1950s, scholars like Torstein Harbo and Reidar Myhre have brought the heritage from Wilhelm Dilthey and Eric Weniger, and more recently Wolfgang Klafki, to the Norwegian audience with their textbooks for teacher training. Along with this influence, Scandinavian educational thinking has also been seriously influenced by Anglo-American ideas. The most important is the progressive thinking of John Dewey and William Kilpatrick, and from the 1950s James Mursell and his principles of "Successful teaching" were widely appreciated among teachers. The American influence implied that the focus was moved from teaching content to students' learning experiences. Educational psychology has also had a strong impact on Norwegian teacher training. But this cannot be compared to the importance of the progressive movement. Empirical-cartesian ways of thinking about education were never any success in Scandinavia. Child-centeredness and focus on students' needs is, however, a common denominator for both educational psychology and progressive education, and child psychology has functioned more as a means of creating understanding for the child's psychological needs and learning problems than for prescribing procedures for effective teaching.
Both the German and the Anglo-American tradition had a clear normative character, even if one pointed towards personal "Bildung" by acquiring knowledge, the other towards the students' needs and activities. These competing perspectives of teaching had both functions as background ideologies

for *the planning of teaching*, either with thoughts of the formulation of national teaching plans or for teaching plans at school and classroom level. They gave a small incentive to some empirical research in didactics.

An exception here is an influx in the 1960s of national and standardised tests to measure the students' level of knowledge. This was a clear undertaking encouraged by American psychometrics and the belief that tests could contribute to increasing the level of education in schools. Similarly goal management, for example with Tyler's rationale and Bloom's taxonomy as a starting point, was well known in the 1960s. Neither the work of test-ideologies nor goal management ideologies gained any foothold in Norwegian education in this period. The "big histories" in Norwegian teaching training were still Herbart, Pestalozzi, Fröbel and Dewey, without defining which of them was most distinguished.

By the 1970s a new direction occurred in Scandinavian didatical thinking towards more *empirical research*. The impulse came primarily from Sweden, where sociological perspectives from structuralistic and partially neomarxist theory gained influence in school and classroom research. Important names were Urban Dahllöf and Ulf P. Lundgren, who are regarded as the instigators of the so-called *frame factor theory*. Attention moved from the process of planning and from the question of what the contents and work methods of teaching *should* be, to an analytical approach where the question is *why teaching turns out the way it does*. Attention was particularly given to how different structural frames, material and cultural conditions contribute to shaping life in school. Ideas from the "hidden curriculum" research were obviously present, as well as inspiration from American structural functionalism, social anthropological ideas and neomarxist conflict perspectives. At the same time there was a spring flow towards new research methodologies, where qualitative investigations opened paths towards new perspectives and new understanding in classroom research. The positivistic, causal research paradigm lost its leading position. We were facing a new type of empirical research aiming at investigation and understanding of relations between different impacts in an ideographic sense, not finding or looking for general principles about causes, effects and predictions in classrooms.

A discussion that crystallised from the frame factor theory was: what controls a teacher's work. According to this theory, a teacher's work could be conceived as a product of external conditions so that the teacher's individual ability to construct his own teaching was limited. "It is not the teacher's fault", it was said (Arfwedson 1985). In contrast to this thesis is the view that the teacher, as a competent and responsible professional, has plenty of opportunity to practise his teaching freely within given boundaries. This discussion will probably never have a final answer even though we are now facing a period with more emphasis on the teacher's independence.

The idea about the teacher's limited freedom has been useful in teacher training. In this context, students are often told about ideals and how things should be conducted in classrooms. During their practical in schools the students experience a reality which can differ greatly from the ideals, and the phenomenon of "theory rejection" and "practical shock" are well known among teacher trainers. One step in the direction of building a bridge between intention and reality is to train students to understand why teaching does not always turn out as the recipe describes. To analyse and understand the real teaching situations, and to distinguish between what teachers can actually do anything about, and what he or she cannot control is an important qualification for all teachers. The Swedes, Gunnar Berg and Erik Wallin, have suggested that all teachers have an unused work space, which means they often think that the barriers are greater than they really are (Berg and Wallin, 1983). To exploit the existing work space turns out as an important challenge to all teachers.

The most important function of an analytical perspective is in the context of evaluation. Evaluation of a school's practice has traditionally been directed towards students' results, often measured by traditional tests. An analytical perspective that includes the whole school's undertaking, including frames and how teachers use them, gives a far more penetrating understanding about how a school works. We should not forget that an analytical perspective will be an important prerequisite to bring about *change and development in schools,* as will be shown below.

Therefore we will find in Scandinavian didactics both a normative and an analytical-descriptive perspective side by side. These two apparently incompatible perspectives have found their place because both seem very useful. Still, little has been done to investigate the relationship between these two basic perspectives and put them together as a whole.

An analytical framework for interpretation of classroom practice

Many models have been made to map the factors that have an impact on the teaching-learning situation. For example one could mention Wolfgang Schulz (1969), Gunilla Svingby (1978), Andrew Pollard (1985) and Michael Uljens (1997). I present here a model that has much in common with these, but it differs from them in trying to include normative and ideological elements as a important group of factors influencing school practice. The model is a foundation in a textbook for Norwegian teacher training (Imsen 1997), shown in Figure 1.

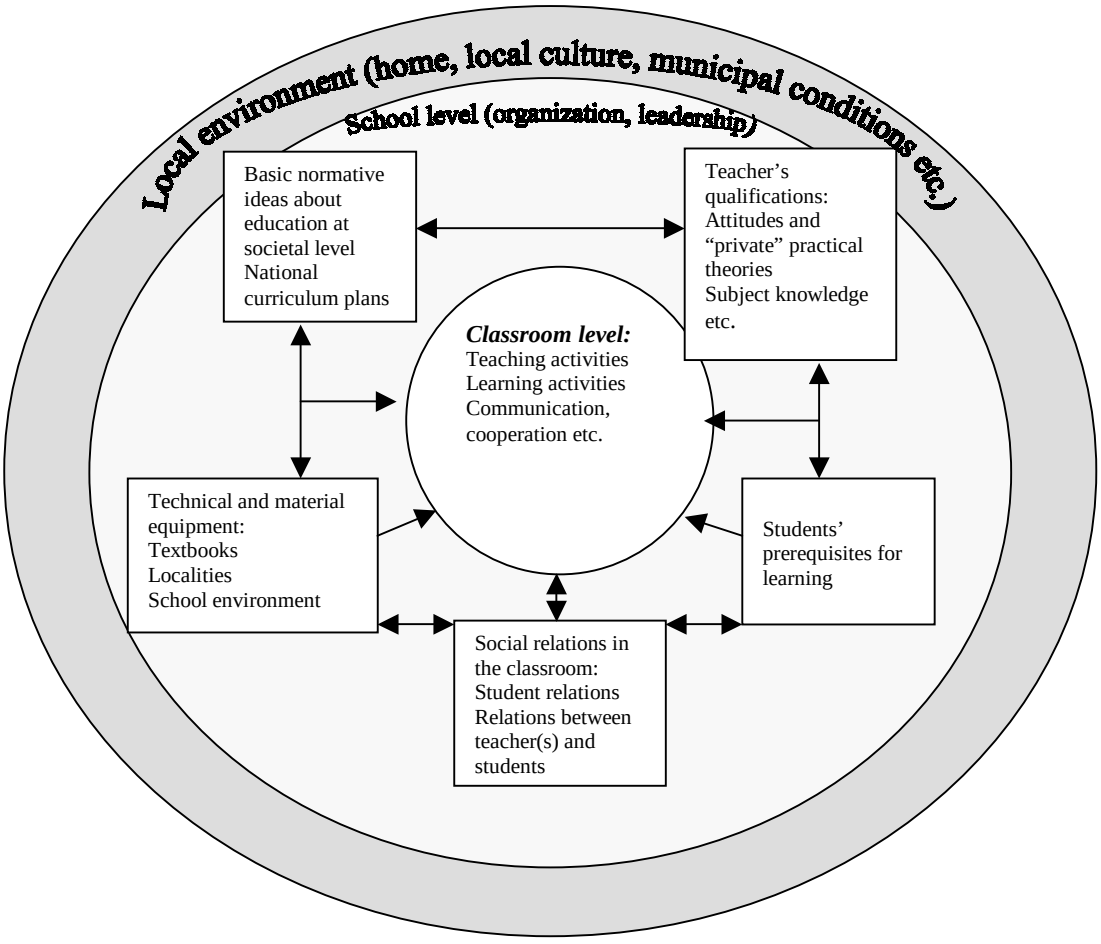

Figure 1 Model for analytical interpretation of classroom activities

At the core of the model is *classroom practice*. This encompasses the teachers' teaching and organisation of students' learning as well as students' learning activities. In short: the life in classrooms is in focus.

The main question is this: *Why is classroom practice like it is?* The question is not only trying to explain why things sometimes go wrong, or why something goes very well. The main purpose of the model is to understand the complex interplay between factors on different levels that makes up the daily teaching routines, providing certain patterns that are well known from so many classrooms. Partly it is about understanding common patterns in most classroom practice, partly it is about understanding why some classroom practice can differ so much from classroom to classroom.

The model has four different levels of social analysis. *The classroom* is the lowest level. It consists of all students in the class and the teacher or teachers at work, and the inter-play between them. A still lower level would have been to focus on the individual student or the inter-play with the other students. For simplicity, that is not included here. That does not mean it is considered irrelevant.

The next level is *school level*. That includes all students, teachers, principal and administrative staff. They work like cogwheels in an old-fashioned time piece, mostly it goes smoothly, sometimes there are problems in the machinery. The school can be considered as an organisation, and this organisation embraces all activities going on at that school.

The school is not an isolated organism that works independently from what is happening outside the school gate. Parents' attitudes and expectations will always influence the principal and teachers' choices and decisions, and there is a difference between running a school in the city and in the countryside. Local culture and local natural environment are important resources for teaching, and local industry and economy give premises for what values are important to transmit in the school. Furthermore, affairs at the municipality and county levels, for instance political priorities about schools and the economic frame, have much to say about how a school works. *Local environment* is therefore a third level of analysis in the model.

The last level, *the macro level*, is represented by the state. It includes parliament, government, the legal system and the social welfare system. The educational system is in itself an important institution in society. The basic conditions for educational activity are decided on this level. In many countries, government and parliament make decisions about curriculum plans for all schools in the country, and sometimes they make decisions about the economic frame as well.

These four levels, *classroom, school, local environment and state* are in a reciprocal relationship to each other. In teacher training, it is important to realise how the state indirectly steers classroom activities through curriculum plans, and how the state is steering schools indirectly through municipalities or counties. Furthermore, it is important to learn how the school works as an organisation, and how leadership and ways of cooperation are influencing teachers' classroom practice.

The most important and perhaps the most evident factors that influence classroom life, are illustrated by five squares in "the inner circle" in the model.

The first factor is *curriculum plans*. In the Scandinavian countries, the state has given curriculum plans that schools must follow to a certain degree of specificity in different subjects. This may vary from country to country, and not all curriculum plans are detailed in the same way. In some countries, the decision to decide about curriculum content is delegated to school level, or even to teacher level.

Curriculum plans will not only be decided from political considerations. Behind most national curriculum plans, there are important historical traditions, partly reflecting conflicting ideological

perspectives or different philosophical ideas about school practice. These ideologies are important to understand, in order to come to grips with the main ideas in the curriculum plans. They say something about how teaching *should* be, and they demonstrate normative ideals for teachers as guiding principles for their work and good advice for their practice.

But curriculum plans never decide about teaching directly. The difference between intention and reality is well known. How the main ideas are to be realised in schools depends on many other factors.

The main road to realisation of a national curriculum plan goes through teachers' heads and hearts. How do teachers conceive and interpret the national plan? Is the plan put away in the bookshelf in the staff room to be doomed forever as unrealistic "curriculum plan poetry"? Or is it used actively by teachers as a starting point for teaching planning? Do the teachers have their own conception of education and methods besides the national curriculum plans, a kind of private philosophy of education? If so, how does this private curriculum play together with the official curriculum?

Teachers' personalities, attitudes, values and reflections are considered as very important factors in the system that decides about the conduct of teaching. At this point, this model differs from traditional frame factor theory. The model allows for teachers' independent and creative organisation of teaching. But the teacher does not work completely on his or her own. There are always other forces that influence teaching, too.

Students' prerequisites for learning are important for all teaching. Learning depends on a stimulating meeting at the cutting edge between what the student knows and does not know. Furthermore, the students' motivation, self-confidence and psychomotor abilities play an important role, besides their linguistic and cultural background. In most countries, the school has an obligation to meet the students at their own level so that teaching as far as possible should be adapted to the students' prerequisites.

Furthermore, social conditions in the class are important for teaching learning processes. What role does the teacher play in establishing the classroom climate, and how does the classroom climate depend on the school climate as a whole? This and similar questions about the social classroom community makes a fourth group of factors that are important to understand classroom life.

The fifth group of factors embraces *material frames* such as school location, localities, textbooks, and other learning resources. In what ways do the material frames decide about methods and organisational learning? Is it the case that the better equipped the school, the better the quality of teaching? Can the teachers use bad equipment as an excuse for not doing a good job, or can a good teacher overcome the barriers of inadequate materials?

None of these five factors influences classroom practice alone. Teaching is constructed in an interplay between all of them. All factors are more or less at work in all kinds of teaching, as we usually know them.

The overall structure of the model is similar to the ecological model of Urie Bronfenbrenner, which says that different levels of society play off each other. In one way the model indicates a structural perspective ("it is society that decides"), but that is only a part of the picture. The model includes normative regulations on teaching that in many countries are decided by the state through national curriculum plans. But the model also indicates that ideas never work directly on teaching, but through those teachers who will translate them into practical activity. To understand this, a

phenomenological perspective is necessary. In addition there is an interaction perspective behind the analysis of classroom activity. The model is primarily focusing on the inter-play between external frame factors and internal social activities. It is not sufficient to explain life in the classroom referring only to the activity inside the classroom walls.

As mentioned, this is not the only model that has been presented about the complexity of school and classroom practice. I do not suggest that this model is better than others, and it will probably be subject to revision and improvement, dependent on teaching context and what the analysis is meant for. A weakness is that the *historical dimension* is not emphasised. That does not mean it is excluded. Much of what is happening in schools has to be understood as inherited culture and structures from earlier times. The normative ideas have, as mentioned, long historical roots. Such is the case with other factors. Teachers' routines, the physical design of schools as well as social conditions in local society all have a past to carry forth with them, both good and bad. History is an invisible background at all levels.

I have chosen to call this model a descriptive-analytical model. It is primarily designed to help students and teachers to understand what is going on in the classroom. What about *planning of teaching and learning*? How can this model be stretched from a descriptive, analysing position to be a tool in the hands of teachers who are continually confronted with the teaching of tomorrow?

Development and change as a challenge for didactics

Education can be legitimised in different ways. In today's society, education is important to secure economic growth, employment and welfare for all. All over the world politicians and educators work both nationally and locally to improve the quality of education and to improve national competitiveness in an increasingly capitalistic society. This is in itself a challenge for schools. In many countries, schools of today experience a conflict between, on the one hand the responsibility to take care of individual students' personal needs and development, and on the other to comply with national and international demands for increased productivity and economic growth. In both cases, there is a strong demand for quality in education and for continuously revising and developing school practice. Society changes, students change and therefore schools have to be changed, too. *Development* is today a challenge no schools and no teachers can escape from. Teacher training must therefore aim at student teachers' ability to develop themselves as professional teachers, not only the ability to reproduce teaching from given models.

The idea of development is not new. In education, John Dewey was among the first to put it on the agenda, with his message that the road to development goes through the student's own, active experience. In the 1970s, the English scholar Lawrence Stenhouse, and many others, transferred the idea of development from experience to teachers and to whole schools as organisations. Just as young students develop through active learning, teachers can learn from their own practice and promote change in schools (Stenhouse 1975). There can be no school development without teacher development. Resisting the Tyler-rationale and the belief that schools can change only by formulating objectives, he claimed another strategy. It is that of teachers' continuous evaluation of their own practice, reflection on their own experiences and the ability to learn from their own mistakes and successes. Description, analysis and reflections about practice are the raw materials for planning new teaching-learning programmes. *The reflective practitioner* became a slogan that was echoed far outside the British Isles.

The idea of school development has been a powerful strategy for improvement in education during the 1980s and 1990s. In today's schools we find a wide variety of developmental strategies, mostly

built around the same pattern. The ideas of teachers' ownership of reform programmes along with the notion of teachers' and schools' learning by experience are at the core of most school development programmes in Scandinavia as well as in many other countries. So is also *action research*, where researchers and experts are climbing down from their ivory towers to join school teachers as partners in their evaluation and developmental work (Stenhouse 1975, Carr and Kemmis 1986). Few ideas about educational research and development have had such vitality and ability to survive critique as action research. The approach in action research is interesting, because it reconciles the problematic dualism between normative and descriptive-analytic didactics.

The main steps in the action research paradigm makes the so-called "learning circle", like the one we know for instance from John Dewey. The point of departure is: look at the result of a series of actions, then learn from the results of these, and use this new knowledge as a base for new actions. In a simplified form the "learning circle" is shown in Figure 2.

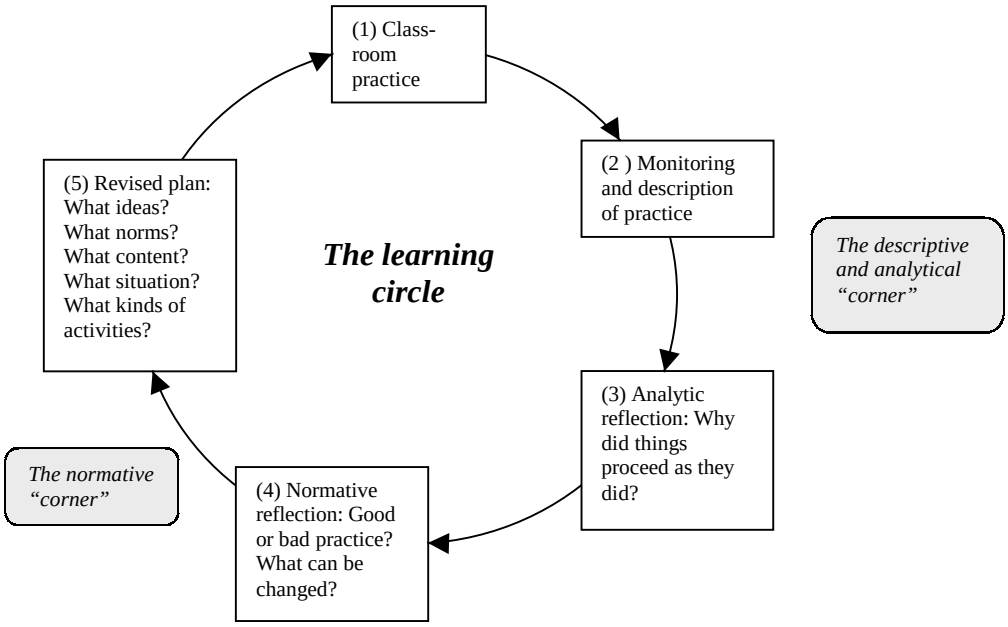

Figure 2 Relation between normative and descriptive-analytical steps in didactical discourse.

This learning cycle contains many partial processes that will not be discussed in detail here. There are a variety of techniques for monitoring and collecting evidence about teaching practice, and teachers face a lot of serious and difficult ethical problems in connection with the conduct of analysis and evaluation of teaching. Not least, there is a series of questions to be asked about the notion of *reflection* – what can be revealed about this phenomenon that appears to be the power source of the whole process? The model does not say what analytical perspectives or what normative ideas are to be applied. In this sense, this model is on a meta-level, including different ideologies and different kinds of analysis. The circle can be exploited individually as well as collectively, and for the whole school as well as for groups of teachers. It can also be applied to different levels of specificity, being valid for teachers' collective work for a joint "ethos" as well as for individual teachers in different subjects. The learning circle is valid both as a general model for school development and improvement as well as for development within special areas of subject didactics.

As a powerful strategy for school development all over the world, this way of thinking should be included in our didactical theories. This seems to be exactly what is happening. The Danish scholar Per Fibæk Laursen is probably right when he claims that in both German, Anglo-Saxon and Nordic

didactics, the focus has moved in the 1990s from planning, on the one hand, to evaluation and reflection on the other (Laursen 1997). There is no doubt that didactical thinking in a traditional, normative sense still has an important role in this context, but this has only to a small extent been visible in those models for school development that have been most prominent so far.

Reflection a bridging concept?

The focus of interest here is the supposed antagonism between what "is" and what "should be". It is argued here that the two didactical paradigms are not incompatible, and that both appear as distinct steps in a complicated learning process. The learning process itself is probably universal, but it is here portrayed with regard to how the individual teacher or groups of teachers can use the learning circle in their planning, conduct, and evaluation of teaching.

How then, can the descriptive and the normative be reconciled in teachers' learning processes? This is partly a philosophical question, partly an empirical one, being at the core of the rapidly growing research about teachers' thinking. One thing is how teachers should think in this connection, another thing is what they actually do. A third question is how the normative and the descriptive ways of reflection can be presented in a systematic way in teacher training.

According to the model in Figure 2, it is assumed that normative and descriptive-analytic didactics meet in teachers' reflections about practice. First, they have to understand what happens in relation to external frames, students' prerequisites, social interactions, local conditions and national curriculum plans. In the next step, they must think normatively and evaluatively about their analytical understanding: Is this good practice, and why? As the last step in the process come revision and new planning: Should practice go on the same way, what new subject content should be chosen, and why? And what kinds of activities should be organised, according to the present situation? In other words: in theory, the teacher thinks first descriptively and analytically, and then normatively about the same problem. The question is whether this is a realistic assumption about teachers' thinking or not, and whether it takes the developmental process forwards.

In the rich research literature about teachers' thinking and reflections during the last two or three decades, there is very little focus upon how teachers sort out or mix these two steps in reflection. Traditionally, research about teachers' thinking has been oriented around three areas: 1) teachers' interactive thinking, 2) teachers' thinking about planning, including both preactive and postactive reflections, and 3) teachers' more general theories and beliefs (Clark and Peterson 1986). One should expect to find some evidence about how teachers handle the descriptive and the normative aspects of reflection in connection with research about teachers' preactive and postactive thinking. In Clark and Peterson's comprehensive review of research on teacher thinking from 1986 (*ibid*.), this problem is not mentioned at all. Indirectly the teachers' normative orientation is suggested because several studies indicate that *content* is the first and most important category in most teachers' planning. In a more recent review, Kenneth Zeichner shows that there is a distinction between those who investigate teachers' planning as a purely rational and logical concern on the one hand, for instance in connection with management by objectives and implicit norms about effectiveness, and those who consider feelings and caring attitudes towards their students on the other (Zeichner 1994). There are also theoreticians who make a distinction between reflection at different levels of abstraction, like Erich Weniger did. Three levels are suggested: 1) teachers' practical actions, 2) teachers' reflections in planning for their practice, and 3) reflections at a more general, ethical and critical level (Handal and Lauvås 1987, Uljens 1997). Investigations seem to suggest that teachers' thinking is most often connected with the first two levels, and that thinking at the third level is rare. It is also difficult to get student teachers to reflect on the higher level because they are more concerned

about their closer, practical teaching tasks. Zeichner is a bit sceptical of this way of thinking about "levels" in teachers' thinking, because it gives a misleading impression of a hierarchical relationship between practical and theoretical reflection. Both forms are important, and he does not want to devalue practical thinking (Zeichner, op. cit.). The problem he is then left with, is that there are ethical and normative principles hidden in all practice, like Weniger indicated, and that these should be revealed at a conceptual level if any evaluation, critical reflection and reformulation about educational practice is going to take place. The normative aspect may easily be forgotten if one is addicted only to practical and technical deliberations.

Research about teachers' thinking has been rather descriptively oriented in order to map what teachers are thinking and how they think, and to a lesser degree been guided by questions informed by theoretical or philosophical problems. The question about how normative and analytic-descriptive didactics can be reconciled in teachers' reflections is still an open one from an empirical point of view. From a theoretical perspective, the relation between the normative and the descriptive aspects of the learning circle is one of the most important challenges for future didactics. There are good reasons to encourage further investigation into this problem, both theoretically and empirically.

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The didactic relation in the teaching-studying-learning process

Abstract

The relation between general didactics and subject didactics is first analysed and the special characteristics of subject didactics are described. With the help of the didactic triangle the pedagogical relation between the teacher and the student is discussed. The core of subject didactics is outlined as the teacher's relation to another relation, that between the student and the content. The manifest part of this later relation is expressed as studying and the latent part as learning. Finally the fact that every teacher has a didactics of his/her own is discussed.

General didactics and subject didactics

The substance of didactics and of research on didactics is the instructional process with all its connected factors. The ideal approach to such an examination would be to look at that process as a totality, taking all possible factors into consideration. It is certainly not possible to include all viewpoints into the design of a particular study. But the framework is totally different when the process is looked at as a whole, as against the alternative approach where the focus rests on some particular component and the totality is not even discussed. Research on didactics in its broadest definition refers to all kinds of research on teaching or, more precisely, on the teaching-studying-learning process (Kansanen, 1999). It must be added that didactics also means pedagogy here. The descriptive side of didactics is characteristic of a research approach and the normative side represents the practical viewpoint, with its arguments and justifications behind the educational decisions. In addition, didactics is always connected with some context in society, with some institution, and it is here that a curriculum comes into the picture. A curriculum restricts the degree of freedom of action. It is pedagogy as a whole that guides the instructional process according to the aims and goals stated in the curriculum.

A general view of didactics differentiates into many particular viewpoints at the level of action. The teacher and the practitioner/researcher need some viewpoint from which to approach the instructional process in practice. Besides general didactics (didactica generalis), special didactics (didactica specialis) concentrates on some aspect that is distinguished from the instructional process for examination. It may be some period of life (Stufendidaktik), some content (Fachdidaktik), some broader content area of education (Bereichsdidaktik), or leisure didactics (Freizeitdidaktik). Another way of looking at the same problem is to discuss theoretical didactics *contra* applied didactics. In applied didactics the theoretical aspect is emphasised and there is a difference in the dimension of generality if we compare it with special didactics. Covertly, at least, applied didactics steers our thoughts to the idea that content may be deduced from some theoretical model or rationale and that practical procedures may be subordinate to theoretical didactics.

Education and didactics is a many-disciplined field of study. It has traditionally been a central content of the educational sciences, whilst other disciplines have made their characteristic contributions when dealing with the questions of education or didactics. Beside didactics some subdisciplines of education are generally mentioned in the literature. The most common are educational psychology and educational sociology or psychology of education and sociology of education (e.g. Röhrs, 1969; Tibble, 1966; Hirst, 1983).

Educational psychology is most commonly defined as the intersection of education and psychology. In that intersection we find an area where the aspects common to education and to psychology are found. If the viewpoint of social psychology is added, this area is often called the social psychology of education. The unity of two separate disciplines brings certain problems, mainly with those who are doing research in this area. It is characteristic of those who come to educational psychology from education to say that educational psychology is a subdiscipline of education, and of those who come from psychology to say that it is a subdiscipline of psychology. This state of affairs only emphasises the common area of both disciplines, that is, the place where they intersect. The same can be said of the unity of education and sociology: educational sociology.

Analogous to the unity of education and some neighbouring disciplines is the unity of didactics and the content that is to be taught, studied and learned. Usually we speak of subject didactics (Fachdidaktik) but the term is not clear at all. Why not content didactics (Inhaltsdidaktik)? We must first answer a very awkward question: what is content? When we speak of subject didactics we are already tightly locked into the level of action and doing very concrete things inside the curriculum. But where do the subjects come from and what is the relation between content and a subject?

It immediately becomes clear that subjects are only a part of the content of the whole. Content in the curriculum is usually divided into various subjects, but there are also other kinds of content that may be common to all subjects or which may be, for example, psychological by nature (cf. Achtenhagen, 1992). There is also a special use of terms depending on how we define subject didactics. On the one hand, subject didactics may refer to some specific school subject, e.g. mathematics, English or history. On the other, it sometimes means a combination of related subjects. If the content is more general, or refers to some area of personality development, we usually regard it as general didactics.

It is interesting to ask how independent the different sections of subject didactics may be. In Germany we speak of *Bereichsdidaktik* and that is also the practice in Finnish teacher education. We combine some related subjects into one area (Bereich) and in this way we have fewer didactic areas to deal with. Typical examples are didactics of mathematical subjects, didactics of natural sciences, didactics of foreign languages, and didactics of physical education. Apparently we can combine those subjects that have something in common with each other. It may be that we can use the same kind of phenomena or the same kind of methodology in acquiring new knowledge. It is problematic, however, just how far we can go with this kind of unification.

The possibility of general subject didactics of a certain kind has also been suggested (Achtenhagen, 1981; Scherler, 1989, p.21; Klingberg, 1994, p.82). It might find a place between general didactics and different subject didactics. Perhaps a range from concrete to more abstract content might be its basis This suggestion is, however, similar to questioning what subjects, or more generally, content, may be combined. Bringing together different subjects with quite different theoretical assumptions may lead only to superficial compilations. Perhaps general subject didactics might be interpreted as a few partly overlapping areas, reducing the variety of subject didactics areas from many subjects to only a few combinations.

The position of subject didactics in the field of education is not completely independent in nature. It depends on how the curriculum is written and what kind of decisions are made. In curriculum making in general the position of subject didactics is political in nature and dependent on educational policy in society. That means that some subject didactics may no longer be in use, or they may change their character in line with societal development if that content is no longer taught in schools. Subject didactics may also be latent, in that sense that we do not know the content that may be produced in future and therefore taught in schools.

Subject didactics must also be seen as a last (or first) concrete link in a circle where academic subjects are one possible starting-point and where school subjects have their own position. If we start from the academic subjects we see that many of the oldest ones are represented in one way or another in the curriculum as school subjects. They are not identical, naturally, but it may be claimed that there is a certain authority in their relations. That becomes visible when we examine teacher education and the specialising of teachers**.** Those university departments in particular subjects are also responsible for the studies of university students in teacher education. Usually the didactic aspects are linked to the subject after some studies in the subject and in education. The situation varies in different countries as to where subject didactics studies are located in the university. It may be in the subject department or in the department of teacher education; either way it means in practice that the development of a school subject is controlled by the academic representatives of that subject. There are exceptions because not all school subjects are academic by nature, but the general trend is that university professors as authorities in their subjects also control the development of school subjects. It is therefore very difficult to break the circle and to introduce some alternative or new models to the content in the curriculum. The development of a new subject from the practical point of view in this circle is extremely difficult and there are considerable problems in achieving a strong position among traditional school subjects. The subjects of civic education (kansalaistaito) or guidance (oppilaan ohjaus) are good examples in Finland; Goodson (1983) also presents similar experiences in his studies of the development of school subjects.

In the course of time there have been attempts to get rid of the separate-subject system of the curriculum. Without going deeply into this topic, the view may be offered that with smaller children the curriculum has often been designed as a totality, concentrating more on unifying themes (Gesamtunterricht) than on the subjects. The vicious circle, however, soon comes into operation: how to build units; how to find competent teachers in the special themes; where is teacher education taking place, etc. An emphasis on the child or on the student puts content into a secondary position and highlights the formal side of education. Content cannot be avoided, its role in any case is central and important, only its systematic representation may be different. However, the larger administrative and traditional boundaries must be broken before it becomes realistic.

We can also conclude that the system of subject didactics follows the disciplines of knowledge. Trying to integrate knowledge into a curriculum is one way of breaking the traditional concept of the separate-subject approach (cf. Beane, 1995). Most school subjects are already multidisclipinary in some way and unity with education makes subject didactics interdisciplinary in any case. The integrated curriculum meets the requirements of everyday life in a natural way. On the other hand, knowledge has gradually developed and differentiated into certain accepted systems that may also be reasonably justified. Development in future will probably attempt to find compromises. One such a compromise has already been experimented with: the main factor steering the application of the integrated curriculum is the age of the students. With older students our experiences of integration are still quite limited.

In spite of the concept we adopt for the role of subject didactics in the totality of the instructional process, its relation to general didactics is essential. This relation can be interpreted in various ways

(Kron, 1993, pp.36–37). Usually we put them opposite to each other with their respective background disciplines. Every school subject has its own base, some in an academic discipline. In teacher education general education forms the background. When we form the intersection of the base discipline and education we get a subject didactics (e.g. Glöckel, 1990, pp.316–324). Plöger (1991; 1994) has described the development of the relation between general didactics and subject didactics in Germany. He states that the dialogue between general didactics and subject didactics that began in the early 1950s gradually diminished and gained special subject didactics emphases. Plöger claims that certain special questions in subject didactics came to the fore, leaving the theme of the relation between general didactics and subject didactics in the background. Questions like the selection of the themes, the position of a subject among other subjects and the hierarchy between subjects, became important in the debate. Concepts were sought in the general didactics and applications were elaborated in various subjects according to the models in general didactics. According to Plöger this was done with too little criticism. In spite of that, the identity of subject didactics was sought in the discipline behind the subject. This trend was closely connected to the reform of teacher education in Germany and the representatives of subject didactics considered themselves as belonging more to the realm of their subject than to pedagogy.

Klafki (1994) has summarised the relation between general didactics and subject didactics in five statements:

1. *The relation between general didactics and subject didactics is not hierarchical by nature. Their relation is, rather, reciprocal. It is not therefore possible to deduce subject didactics from general didactics. They both deal with the same problems and although naturally a certain subject has its typical characteristics their difference lies predominantly in the possibility of generalising their solutions and decisions. Reduction of subject didactics to general didactics is not possible and general didactics has no immediate consequences in subject didactics.*

2. *The relation of general didactics and subject didactics is based on equality and constructive co-operation. Their approach may, despite that, be divergent.*

3. *General didactics and subject didactics are necessary to each other.*

4. *The role of subject didactics between the discipline and education is not only mediatory, it must be seen also as independent with its own contributions to the common area of education and the subject.*

5. *General didactics aim at as comprehensive a model as possible but that does not mean that those models could include the entire instructional process. The models in subject didactics may, however, be made in more detail.*

At the level of action in the teaching-studying-learning process the integrated curriculum has aroused much discussion and also opposition. The arguments presented for and against integration also reflect attitudes in the discussion of the relation between general didactics and subject didactics. Beane (1995) claims that the separate-subject approach derives from Western-style humanism and is deeply rooted in our thinking and in the academic knowledge system. Beane also presents some factors that protect and contribute to the stable position of the separate-subject approach in the school curriculum and teacher education. First of all there is a network of academic elites with symbiotic relations. Beane refers among others to many academics and teacher educators, test and text publishers, subject-area associations whose identity and advantages are linked to particular subjects. Secondly, parents and other adults are unlikely to choose radical alternatives. Furthermore,

teachers have their identity in the very subject they have studied and are teaching. There is also a certain ranking among subjects that tends to strengthen teachers' own beliefs. Finally, Beane claims that we are living in a very conservative era.

Separate-subject approaches in the curriculum and subject didactics have many characteristics in common, indeed they both are based on the same knowledge system. It is reasonable to claim that the same problems are encountered when trying to combine certain subject didactics to area didactics (Bereichsdidaktik). Klafki, however, considers subject didactics and area didactics as parallel in his five theses (1994). The interpretation may be that he has nothing against combining some relative subjects into a common area. Conceptions about this matter are, nevertheless, extremely varied. In the Finnish system of teacher education, area didactics has already been realised for twenty years. Although it must be added that there are economic reasons for this decision, it has functioned reasonably well. Didactic research literature in the respective areas has increased and the number of doctoral students has continually increased.

Contrary to the positive attitude towards area didactics, is the point of view taken recently by the chairpersons of associations of subject didactics in Germany (Konferenz, 1998). They are strongly against combining neighbouring subject didactics into fewer units of area didactics. Among many other arguments it is repeatedly stressed that every separate subject didactics is strongly connected to its discipline and to its knowledge base. The different subject didactics must be seen rather in close co-operation with each other, so that this way they are together able to fulfil their interdisciplinary assignments. The problems of overlapping separate subjects are a challenge for the co-operation of specialists in subject didactics; area didactics is called something like "imaginary super science" (imaginäre Superwissenschaft) and is claimed to be impossible. As noted earlier, an integrated curriculum and area didactics must not be considered identical nor corresponding directly to each other. A possible solution to overlapping subjects or integration of subjects is interdisclipinary co-operation; combining separate subject didactics into some kind of combination is not the right way. The chairpersons are also taking a stand in relation to curriculum integration when discussing such subjects as civic education (Sachunterricht) and field of work studies (Arbeitslehre). To constitute a school subject from a practical point of view produces a different kind of subject, not based on any discipline, and the chairpersons (Konferenz, 1998) are not referring to such compilations. We tend to approve of this last view but it leaves the development of didactics for such compilations open. Furthermore the suggestion that many subject didactics are broad and heterogeneous is true, for example biology as a subject contains knowledge from many different areas.

The position of subject didactics as a special area of didactics is not a simple one. Although the viewpoint here is content, it must be borne in mind that subject didactics is only one special angle from which to look at the problems in the field of didactics. Beside subject didactics we need some other perspectives. The point is, however, that subject didactics traditionally has a very strong position. As we have indicated, there may be alternative ways of looking at things; examining and experimenting with them will prove their future usefulness.

Subject didactics has been thoroughly dealt with in German didactic literature. It has, of course, its corresponding field in Anglo-Saxon research on teaching. The tradition and the cultural context there, however, are totally different. Lee Shulman (1987) has introduced his term 'pedagogical content knowledge' and it has been noted to resemble the German *Fachdidaktik* quite closely (cf. Gudmundsdottir and Shulman, 1987; Gudmundsdottir and Grankvist, 1992; Nordenbo, 1997, pp.123–130). In spite of this, systematic analytical literature, comparable to that in the German context, is still lacking.

The didactic triangle as a means of understanding subject didactics

In addition to the participants in the teaching-studying-learning process this process itself has some purpose, it aims at something. The purpose, aims and goals are defined in the curriculum. The relation of the participants, the teacher and the students, is quite often described with the didactic triangle according to Johann Friedrich Herbart (Peterssen, 1983, p.46). What the content is in the teaching-studying-learning process is a very complicated thing. Put briefly, the content is not restricted to various subjects, it may in fact be extremely versatile, as e.g. Shulman (1987, pp.8–9) and Wilson, Shulman and Richert, (1987, p.114) have described. This has been taken into consideration when presenting the didactic triangle. The didactic triangle is usually presented with the teacher, students and content as its points. There are, however, numerous variations depending on how the points are understood in a larger context where the societal factors are explicitly drawn out (Paschen, 1979; Künzli, 1998).

Although the didactic triangle should be treated as a whole, it is almost impossible to do so in practice. That is why it is usually analysed in pairs. The most usual approach is to take the relation between the teacher and the students as a starting point (Figure 1). When this is seen as a pedagogical relationship it brings with it certain special meanings. Even when the students are adults the pedagogical relation between the teacher and the student is, still, however, asymmetrical. In the pedagogical relation the teacher has something that the students do not yet have. In other respects this relation may be more democratic. When the students are children the asymmetric quality of the relation is emphasised.

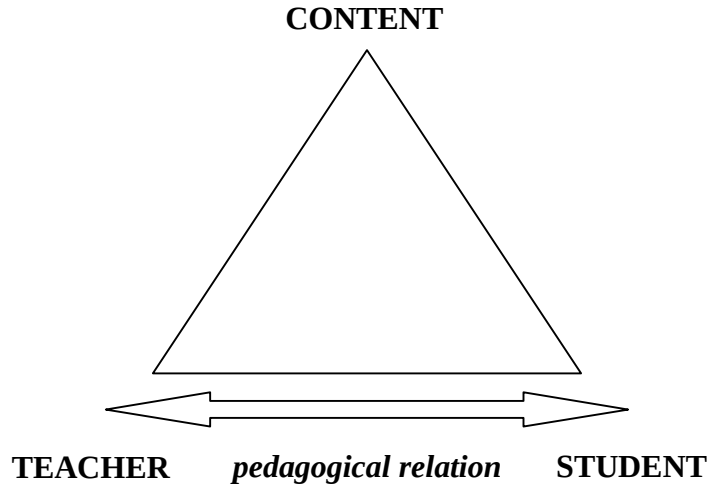

Figure 1 Pedagogical relation in the didactic triangle

In the *Geisteswissenschaft* pedagogy the relation between teacher and student is one of the basic concepts. In the thinking of Herman Nohl this relation has been of special importance. Wolfgang Klafki (1970, pp.55–65) has summarised it by stating that this relation is necessary from the point of view of a young person and it aims to draw out his/her best. The content of this relation has to be thought through in each situation; it must be interactive in nature, a student cannot be compelled/ forced into it. It is not a permanent relation, but one which the young person gradually grows out of, developing into independence. This relation also gradually takes shape as the development of the young person brings with it different perspectives. In pedagogical discussion this characteristic has often been referred to as “the pedagogical suicide of the teacher” or the “pedagogical paradox”, according to Immanuel Kant.

The character of the pedagogical relation is such that it may be organised in a variety of ways. In principle there is almost complete freedom to construct interaction in the teaching-studying-learning

process. The various emphases may also be described by drawing the didactic triangle accordingly. Jürgen Diederich (1988, pp.256–257) presents some examples. An authoritarian atmosphere stresses the teacher's personality; student-centered methods emphasise the student's role; competence in the content means expert knowledge of some subject, and understanding of the student's personality refers to psychological interaction, etc. Klaus Prange (1986) describes the dimension between teacher and subject matter as doctrinaire, the pedagogical relation, from the teacher's point of view, as ethical, and the teacher's knowledge of the student as maieutic.

In the relation between the teacher and the content, the teacher's competence in content is the main focus. From the point of view of subject didactics, the important issue is the balance between subject knowledge and pedagogy. It is a common sense view that the requirements in this respect are greater the older the students are. The limits of subject-matter expertise are easily defined. To be a teacher s/he must have something that the students do not have (cf. McClellan, 1976); in the area of content knowledge this means sufficient academic or professional studies. In principle the competence of the teacher can never be too great but if it is beyond what is necessary it may be of no use. It is also important that the teacher's relation to the content is sufficiently many-sided and that there is sufficient pedagogical competence. A combination of expertise in subject content and pedagogical competence is a good starting point, but more specification is needed to fulfil the requirements of subject didactics.

Traditionally, understanding the content aspect of the didactic triangle has meant discipline-based content knowledge that relates to curriculum questions rather more than to questions of general pedagogy. We have, however, considered content as somewhat more comprehensive than pure subject-matter and thus nearer to the core of subject didactics as it is generally understood. This underlines the limitations of using models such as the didactic triangle. However, in spite of their simplification, such models may be of help in the conceptual analysis.

The didactic relation – the core of subject didactics

The student's relation to the subjects, or more generally to the content, is the key to didactic understanding. The content is defined in the curriculum as subjects and other content. The whole instructional process aims at achieving the aims and goals stated in the curriculum. Most of the outcomes from the teaching-studying-learning process are learning results but behavioural changes through an individual's own free will in response to the activities in the instructional process are also consequences of the same process. Learning and other desirable changes, or more generally the defined development of a student's personality, are the primary purpose of the teaching-studying-learning process. It may thus be said that the consequences, learning included, form the most essential aspect of the relation between the student and the content.

It is well known that teaching in itself does not necessarily imply learning. Rather, teaching is a kind of action that is aimed at pupils' learning or other kinds of outcomes, without any guarantee on the teacher's part (e.g., Smith 1961, 1987). If we describe the activities of the teacher as teaching, we would prefer to call the activities of the students as studying (cf. McClintock, 1971; Uljens, 1997, pp.34–43). It is this studying we can see and observe in the instructional process. In other words, the relation between the student and the content is visible as studying, doing something in order to achieve the aims and goals in the curriculum. The invisible part of this relation may be learning and other consequences of the instructional process. Learning is taking place in a student's mind and in order to learn the student is expected to do something, to study. For the teacher, to bring about learning is the central task but to control the learning taking place is theoretically impossible. What the teacher is able to control, or rather to guide, is studying.

In any case, the most important determinant in the teaching-studying-learning process is the student and his/her achieving the aims and goals of the curriculum. The teacher's task is to try to guide this relation (Figure 2). First, there is a relation between the student and the content. This is manifest as studying, and latent as learning and other changes. Secondly, the teacher has a relation to the relation between the student and the content. In other words, the teacher has a relation to studying, and at the same time this relation is also to the learning and other processes. That may be called didactic relation (cf. Klingberg, 1995, pp.77–84). It is important to notice that the didactic relation means a relation to another relation.

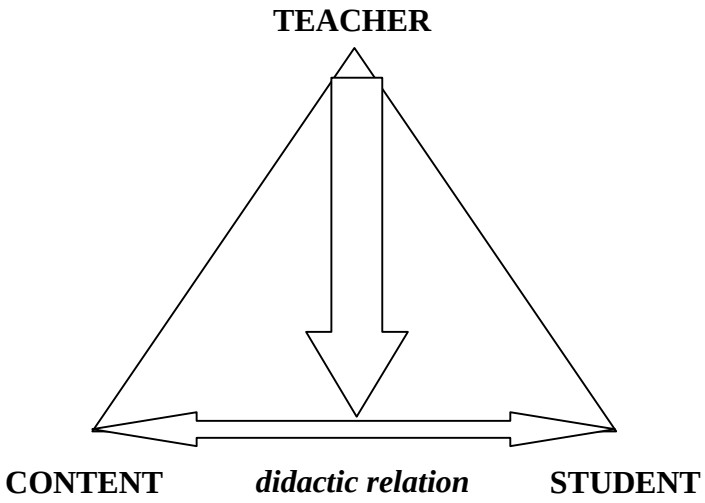

Figure 2 The didactic relation in the didactic triangle

To highlight the importance of the didactic relation it may be emphasised that concentrating on the content makes the teacher an expert and concentrating on a student makes the teacher a caretaker of the pedagogical relation. To concentrate on the relation between the student and the content or on studying is, however, the core of a teacher's profession.

A teacher's didactics

The didactic relation viewed as a teacher's relation to studying has some immediate consequences. It is difficult to believe that the didactic relation could be universally organised or according to certain technical rules. Each teacher is supposed to think and decide for him/herself how to handle it. It follows that every teacher has a didactics of his/her own. This comes close to the concept of a teacher's practical theories (Elbaz, 1983) or a teacher's pedagogical thinking (Kansanen, 1999). Didactic models or textbooks may help but they do not remove from the teacher a personal responsibility in making educational decisions.

A further aspect is the context of the didactic triangle. It has been claimed that wider societal conditions are not taken sufficiently into consideration. Adolf Diesterweg suggested a fourth factor which he described as outer conditions in the context of where the students are living (cf. Klingberg, 1995, pp.84–85). Although it is true that the didactic triangle is an abstract construct it is always situated in some context. The question is, how many of these outer conditions must be explicitly stated and how many belong to that context where the triangle is situated. In school didactics the instructional process is always guided by some curriculum and relations to larger societal determinants are defined through it. If these societal conditions are emphasised it is natural that they will also receive more attention.

The development of research on general didactics has responded to the importance of considering wider societal conditions with a concept of school pedagogy. It is also a German peculiarity, like didactics. It may be described in comparison with didactics. Glöckel (1990, pp.322–324) offers a historical explanation of their differentiation. Didactics has developed as an essential part of general pedagogy and teacher education. Almost all teaching took place in schools and school pedagogy was central in didactics. Teaching is nowadays, however, a broader concept, also taking place outside schools and didactics is not limited to schools. The same may be said of school pedagogy; it refers to broader societal conditions. Didactics concentrates mainly on the individual and refers to educational psychology and to the theory of teaching. School pedagogy is mainly interested in organisational factors and refers to educational sociology and to the theory of school. When didactics has its background in philosophy, school pedagogy is interested in political sciences. The most important names in didactics are Wolfgang Ratke and Johan Amos Comenius while the respective names in school pedagogy are Johann Friedrich Herbart and Friedrich Schleiermacher. The contemporary representatives, among others, are Hans Apel (1990; 1993) and Wolfgang Einsiedler (1991). It must, however, be emphasised that most of the problems and themes of didactics and school pedagogy are common.

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On central dimensions of teacher education – a Finnish perspective

Abstract

By necessity teacher education covers two dimensions. One is defined by the applied work that is carried out by each teacher every day. Another is the knowledge formation that gives the understanding of the nature of teachers' work. The latter dimension is expected to be founded on scientific principles.

In many ways this dualistic nature of teacher education raises problems and difficulties regarding what should be included. In our view, two principles should govern teacher education. One is the idea that teacher education is an academic scientific discipline, in the same sense as is valid for the education of medical doctors. The implications of this approach are that the foundations for the education of student teachers must be scientifically secured and founded on scientific knowledge. It also means that teacher education is a scientifically defined area where knowledge can be accumulated. This contradicts to some extent the idea of apprenticeships, the master and apprentice concept of teacher education. From this perspective, the question of what knowledge is needed in teacher education and how knowledge can be accumulated is of central interest.

The second idea influencing teacher education, related to the one presented above, is the importance of scientific preparatory training given to each student teacher, resulting in research that is presented in a master thesis. From this several implications can be drawn. Among these, the major importance must be given to the students' knowledge formation and his/her ability to fulfil expectations as a teacher in the future.

In our presentation the two principles presented above will be further discussed and their implications for the content of teacher education will be pointed out.

Background

Internationally, the strongest emphasis on teacher education is to educate well qualified teachers for the educational system. This means that teacher education is seen as a vocational training for students who want to acquire competence for a specific profession. The major aim for teacher education is then to educate students in the profession of being a teacher.

This aim is in many ways similar to the education of, for instance, medical doctors. The general idea is that a student during his/her studies will acquire the competence necessary to carry out the trade in an acceptable way. But, by contrast with another aim of medical education, internationally teacher education does not offer such a scientific training that is basic to a profession. It is very common that teacher training is not located in a unit at the heart of the university or is completely removed from the university and independent from the university level of education. This is logical

and reasonable if it is believed that the education of teachers is a vocational training of students into a profession where scientific knowledge and the potential to understand, evaluate and carry out scientific work is of less importance compared to other dimensions of the teachers' work.

However the fact that the education of teachers is very often organised and viewed as vocational training is not easily parallelled by the view that there is scientific knowledge to learn about the teacher and his/her work. One obvious problem concerns the accumulation of knowledge about the area of teachers and teaching. If it is not considered a scientific discipline no methods, no theories and no research will be developed or organized in a way which will allow that knowledge to be acquired and research will seem to be 'worthless' to carry out.

Defining education from this perspective leads to the question about how to organize the education of teachers to meet the functional needs present. This task has been the main academic problem since the 1970s when Finnish teacher education was integrated with the university system and then defined as a scientific discipline comparable in every respect with other more traditional academic disciplines. In this chapter we therefore want to address issues which together can be regarded as an outline of a didactics of teacher education.

Historical overview

In order to provide an understanding of the present state of Finnish teacher education we want to briefly touch upon some general aspects of its history. The process of 'universitization' of Finnish teacher education has progressed so that today almost every kind of teacher education is university linked in one way or in another.

As in many European countries, initial teacher education for primary school teachers has its origin in a seminaristic tradition. For more than a century primary school teachers were educated in seminars. In the 1970s teacher education for primary school teachers changed drastically and was incorporated into the university system. Initially primary school teacher education was not integrated into the university degree system. But from the beginning of the 1980s primary school teacher education became fully integrated and linked to a master's degree.

Secondary teacher education was structurally, and from the point of view of the content, reorganized during the same period as primary education. Secondary school teacher education has been rooted in an academic tradition whereas teacher education has been carried out in specific training schools outside the universities. During the 1970s the educational studies were transfered to universities and to the established faculties of education. This means that subject matter studies are offered by the different departments of the academic scientific disciplines, while the teacher education is provided by the departments of teacher education at the faculties of education. The main part of the courses are scientific studies in 1–3 subject areas. Usually the subject-matter studies offered by departments of different subject areas are not connected to didactics or directly to school subjects. According to the valid legislation it is stipulated that secondary teacher education shall comprise at least 35 study weeks, of educational theory and practice (Myrskog, Sundqvist and Wenestam, 1992).

At one time special needs teacher education was arranged in supplementary courses mainly adapted for primary school teachers. Today, education for special needs teachers takes place in separate departments of the faculties of education. The main subject area is special education. The structure and duration of the study program is similar to the primary school teacher education programme. It is also possible to become a teacher for children with speecial needs by adding one year of studies after finishing primary school teacher education.

Pre-primary or pre-school teacher education has mainly been offered in nursery teacher colleges, but since 1995 this education has been provided only at universities. Pre-school teacher education is linked to a bachelor's degree, which means that the studies will take about three years. In the Finnish context the notion of pre-primary education means a systematic education and preparation covering the ages until the year before children's entrance into the comprehensive school. Pre-primary education is mainly offered to 6-year-old children, traditionally in daycare facilities, but to some extent also integrated into the comprehensive schools. In this case pre-primary education requires authorisation from the Ministry of Education. As in most other countries pre-primary education is designed to support the parents in fostering their children and promoting personal growth and learning. (Developments in Education 1992–1994. Finland, 1994)

The picture of vocational education and vocational teacher education is more diverse than primary and secondary teacher education. There are problems in separating vocational education from vocationally oriented adult education and from vocational education as a part of in-service training. Depending on the content of its course a certain training programme may be characterized as vocational education, while it may be regarded institutionally as pre-service and/or as in-service training.

The expansion of school based vocational education in Finland, as in many other countries, is closely linked to the period of industrialization. Vocational schools were established according to new needs in different fields, i.e. different branches of industry, agriculture, forestry, health, caring etc. Teacher education was specialized and branch specific. This system existed with only slight changes until the 1970s. The overall tendency in the reform has been to homogenize the whole structure of vocational education and as a consequence to integrate teacher education for different vocational sectors. The educational preparation of vocational student teachers comprises, like secondary school teacher education, 35 study weeks. In the Swedish part of the educational system of Finland vocational teacher education is offered by Åbo Akademi university (Hansén, 1996).

The present state of Finnish teacher education

Against this outline our attempt in this section is to highlight some central features characterizing the present state of Finnish teacher education. Our main focus will be on primary school teacher education because it is wholly provided by the departments of teacher education and educational science is the main subject. In the first part of this section we will address the structure and the content of the programme. In the second part we will draw attention to the emphasis laid on educational science and educational research in the programme.

The structure and the content of teacher education – the case of Åbo Akademi University

A central principle in Finnish departments of teacher education is the close relationship between research and teaching. All departments offer basic university degree programmes as well as doctoral programmes.

Post-graduate studies up to a master's degree for primary and secondary school teacher students have been an integrated part of the total study programme. The subject area for the master's thesis of primary school teacher students is educational science (75 credit units, one credit unit corresponds to 1.5 ECT), while the subject area for secondary school student teachers varies and is carried out in different faculties and departments. In the main subject, in which the thesis has to be written, the number of credit units has to be at least 55. A credit unit in Finnish universities is used for a student's estimated average achievement in fulfilling the aim of a certain study unit such as a course or practice etc., which means that 40 hours of work corresponds to one credit unit.

Departments of teacher education provide a full programme up to doctoral level. Every department of teacher education carries out research projects either individually or group based. Funding of the projects varies. The universities themselves finance some of the projects and the Academy of Finland finances others. Furthermore, there exist foundations, institutions and associations which also support research.

At the core of the teacher education programme is the teaching process, implying a range of theoretically and practically oriented studies. During different phases of the programme various aspects of the teaching process and the contextual conditions will occur cumulatively. Theoretical and practically oriented studies are intertwined and many teacher educators, representing pedagogy, the subject matter studies and schools are involved. Although in reality there is a false dichotomy between the two phases of preparation, they are at least physically partly separated. The theoretically oriented preparation takes mainly place at the departments of teacher education within the universities. The practically oriented preparation is mainly located in separate training schools, and to a minor extent also in so called 'field schools', i.e. regular schools in the school system.

Efforts to overcome the incompatibility between the two phases of preparation is a well known problem in Finnish teacher education, as in many other similar educational systems – see for instance the report from the international group on Danish vocational teacher education (Evalueringscenteret, 1999). The authorities are well aquainted with the problem and the Ministry of Education has, during 1997–1998, provided funding for several projects aimed at developing teaching practice and making more connection between theory and practice. These projects are distributed among the departments of teacher education at the Finnish universities (Letter from the Ministry of Education 25.3.1998). The intention is to elaborate practical preparation as an essential part of professional development and its integration with the more theoretically oriented preparation.

In a project we have recently started at Åbo Akademi University the aim is to strengthen the ties between theoretically oriented courses and practice in our training school. For instance when students take courses in educational psychology the related practice is partly aimed at focusing on single individuals in groups. Thus, student teachers are for instance collecting data by observing or interviewing students in classrooms and subsequently compiling and analysing the material and finally presenting their findings. During other courses student teachers may start by doing various field studies, for instance following a headteacher's or a teacher's work, participating in schoolboard meetings, meetings with parents etc. In this kind of inductive approach the theorizing will, in a concrete way, derive from the experience gained. Lecturers at the department of teacher education and lecturers in the training school are together responsible for the project, which has meant increasing cooperation, new patterns of tension but also a deepening mutual understanding of each other's work.

The need for restructuring parts of the practically oriented preparation is also pragmatically related to the structural change in the comprehensive school and the division of labour between class teachers and subject matter teachers. The administrative demarcation line between the lower (grades 1–6) and the upper (grades 7–9) stages will be eliminated. This change means in practice that class teachers can work in the upper stages and the subject teachers in the lower stages of the comprehensive school under certain conditions (Education and Research 2000, 1996). The practically oriented preparation has to be adjusted to the new situation.

The traditional content of practice, almost exclusively directed to teaching practice, has also been questioned. Studies show (Gonnie van Amelswoort and Scheerens, 1996) that nearly half of teachers' working time consists of non-teaching activities such as school-based curriculum work, collective

planning, cooperation with parents, outdoor activities etc. Practical preparation alone is not considered to provide the ideal way for student teachers to face the reality of school work.

An appropriately organized practice offers broad contact with the totality of the elements constituting school work. This means not only lesson planning and teaching, but also possibilities of exploring new teaching strategies, participating in the dynamics of collaboration with colleagues within various projects and with different actors and actor groups, like parents and local authorities, and tutoring students with special needs and social problems. Student teachers also need to get opportunities for resolving social conflicts and become aquainted with externally localized factors influencing pupils and school work.

A scientifically based and a research based teacher education

What is the meaning of the notions 'scientifically based' and 'research based' teacher education? Teacher education in general has abandoned the concept of mainly relying on knowledge and skills generated through experience. The tradition of a corpus of knowledge, skills and rules of action has partly been replaced by a scientifically produced knowledge base for understanding and action. The staff involved are expected to be well versed in educational science and thus able to use educational theories as guiding principles for practice. Student teachers' programmes are strictly built on educational and neighbouring sciences.

While all western teacher education programmes would claim to be scientifically oriented Finnish teacher education, in addition, also claims to be research based. What does this mean? Generally speaking it means that both students and the staff are participating in doing research. Finnish teacher education is not only oriented to educate staff and students to be wise consumers of educational science. The kind of reflective thinking its teacher education is trying to promote starts from a research based approach, which is designed to permeate teacher education as a whole (Kansanen, 1997).

For the staff this means getting actively involved in research projects and becoming an integrated part of the research society. Since the beginning of the academic year 1998–99 the basis for calculating teachers' working time has changed and is no longer strictly related to a fixed teaching load and other teaching activities. The increased flexibility is aimed at enabling improved possibilities, especially for lecturers, to combine teaching and research.

Students must have acquired approved competence in carrying out their own research in the area of education. Students' research training progresses steadily from the very beginning of their teacher training studies until their final examination and is fully integrated in all courses. There are, however, courses directly focusing on research capability. Although we cannnot go into detail here, it may be worthwhile to present a general outline of the courses forming the core of the research training part of the teacher education**.** One such course is called 'Education as Science'. This course is at the very beginning of the study program. Its major aim is, of course, to give an overview of the scientific basis for education.

For student teachers research based studies become explicit in two phases. The first phase (*cum laude* level) contains courses in research methodology and writing an essay, comparable to something like a bachelor's thesis. The students meet more research oriented courses and assignments. The demands are raised and the student is supposed to take an active part in various research preparation tasks. A suite of basic courses directed at training the student in research methodology is offered to the student at this level. They are initiated by a course labelled 'Introduction to Research Methodology', which discusses general research methodology and how to conduct research.

Furthermore, basic courses in quantitative and in qualitative metods are offered. The aim of these courses is, of course, to acquaint the student with very concrete ways of carrying out research and the analysis of research data. The theoretical aspects of research methodology are also discussed. This part of research training is aiming at making it possible for the student to carry out minor research tasks. This phase occurs during the second and the third year of study.

The aim is on the one hand, to train students to collect and process data in a systematic way and, on the other, to utilize research findings and to structure and compose an essay. The main responsibility for this part of the studies rests upon the lecturers. The essays are presented and evaluated in seminars.

The second phase (*laudatur* level) also consists of courses in research methodology and writing of a master's thesis, but at a more advanced level compared to the first phase. Students take a course on the 'Philosophy of Education' and advanced courses in quantitative and qualitative research methods meeting the standards set by the scientitific society. Besides being part of students' general education into familiarity with scientific research, the courses also support the student's own research work, which mostly includes gathering empirical data and analysis of the data. The research is a part of the teacher education and must be completed in order to fulfil the requirements for the degree. The research work carried out by the student is subsequently presented as a Master's thesis. Topics are chosen so that they fall very closely within the supervisor's area of competence and often they are in complete agreement with the supervisor's own research. Professors supervise the research carried out by students and have the main responsibility for the thesis and seminars, where the students' research is evalutaed by their peers. Students' own research is therefore supervised by experienced researchers. The peer evaluation is organized according to the general principles that govern all scientific work, as are the doctoral disputations, and is also a part of the research training programme.

When the thesis is finally accepted by the responsible supervisor, the author is allowed to print and bind it into a book which is presented to the examiner. The dean of the faculty then appoints two official evaluators, who, independently of each other, write their reports on the scientific merits of the thesis. These reports are presented to the Faculty Board together with the thesis for final approval.

The scale of marks used has eight levels; from *laudatur* (excellent) to *improbatur* (not accepted). Some of the outstanding theses, that is those receiving the highest mark, *laudatur*, may be accepted for a Licentiate thesis. If a student has received one of the three highest scores he/she is eligible to apply for doctoral studies.

The research training formalized by writing the Master's thesis forms an essential part of the student teachers' programme during the final part of their studies and is directed towards preparing students for critical thinking and for becoming capable of autonomous decision-making and thus prepares them for action guided by gradually elaborated practical theory. Today, an essential part of the theses consists of empirical studies on various aspects of the educational field.

The underlying intention of this research education as a whole is to make an explicit demand on students to acquire both knowledge about the scientific basis for the education they are experiencing and the basic skills necessary to carry out research. Literature for the courses is chosen because of its scientific merits related to its content. The goal is to include only such literature which can be justified by its scientific qualities.

To be more precise, the aim of the research training is to help the student acquire an understanding and a way of reasoning about education in terms of its scientific qualities. That means that students

learn how to discuss and argue by reference to scientific knowledge and do not simply rely on everyday thinking and 'magical' or 'mystical' arguments.

Furthermore the aim is to educate students to be critical and sceptical until valid arguments are presented. This means that during their education as teachers they are encouraged to discuss, and not simply to accept, the issue that is presented to them but to ask for scientific evidence. Staff are expected to encourage this behaviour although it sometimes makes life very difficult for them. It should be observed that teaching staff should have acquired at least a licentiate degree in order to be qualified to hold a permanent position at the department. Many of the faculty members are doctors in philosophy or in education and are actively pursuing research in parallel with their teaching duties.

Discussion

In our exposition we have discussed aspects on the present state of Finnish teacher education against the background of a brief historical overview. The discussion has been limited to two characterizing features. First, we have analysed the structure and the content of teacher education, by using teacher education at Åbo Akademi University as a case study. Second, the discussion has centered around the relationship between a scientifically based and a research based teacher education. Together the perspectives discussed have represented an outline for viewing a didactics of teacher education.

These two areas of characteristic features form the prerequisite for understanding Finnish teacher education. The structure and content are aimed at supporting the emphasis on research. It follows from the reasoning presented above, that it is logical to organize teacher education in a similar way to that in which scientific disciplines are organized. It is necessary to view the education of teachers in such a way that knowledge can be derived from it. This condition is met by defining teacher education as a scientific discipline existing under the same rules as any other discipline. That means that teacher education is seen as an area of knowledge from which information can be gathered and analysed according to scientific principles. It also means that the knowledge obtained can be used as the scientific foundation for the education of the teachers.

The knowledge dimension constitutes accumulated understanding about being a teacher and doing the work of a teacher. This is the major area of interest for the education of student teachers into professional teachers. But it must not be forgotten that a huge amount of important knowledge is acquired through our experience as human beings and, later, from the professional experience of being a teacher. Everyday events, situations and problems that are not possible to list, or even delimit from ordinary life in school, form this experiential knowledge into a personal data base of world knowledge, tapping innumerable areas of personal and professional competence. Without any doubt this kind of knowledge is closely related to teachers' general competence.

Another part of the knowledge dimension is, however, possible to delimit and to make the content of systematic teaching. The knowledge concerned can be defined as 'documented knowledge'. In order for this kind of 'frozen knowledge' to be part of the content of teacher education it must meet certain criteria of quality. It must be

1) secure, in the sense it cannot be of a casual nature
2) valid, that is knowledge that can be trusted to be true
3) possible to control and to investigate, in order to verify it.

In the light of 1–3 above, knowledge must be possible to validate or refute. This leads to the basic arguments for Finnish teacher education as it is offered at the Åbo Akademi University.

Training student teachers as researchers means that they learn by their own experience how to analyse and to evaluate knowledge. They learn at least the essentials of how to carry out research, they discover research methods, difficulties and risks and they know how to read tables and graphs, and so on. They are also educated in making use of scientific knowledge and information and organizing their thinking in a way that is scientifically acceptable and approved. This means that they are able to approach information from various sources in a more critical way than if they hadn't acquired research experience.

Furthermore, the students are prepared to continue their studies in different areas. They are also, if their theses are evaluated as scientifically qualified, eligible for the doctoral programme. No extra or overbridging courses are needed in such cases, taking time from the research training, as for example in Swedish teacher education. Neither do the students have to turn to the university for continuing their advanced level studies in education.

It can be expected that in future teacher education will face even stronger emphasis on education as a science, because of the increased distancing from past tradition – the seminaristic tradition. The strengthened relationship between the economy of the university and the need for scientific production will have an effect on the organization of students' research, making it worthwhile to include it as part of the professional research output. Thus students' research, after being presented as master's theses, would be transformed into articles for publication in scientific journals. Since the research carried out by students makes up a very large part of the total research output at the department this would be a very sensible result.

In conclusion we want to underline that we have not told the full story of Finnish teacher education. The description represents reality but more idealistically pictured, in a way which shows the intentions behind the present concept of teacher education. In the daily trot Finnish teacher education is facing many problems related to the scientifically and research based approach. Several factors are making the development of the scientific approach to teacher education troublesome. Not every student teacher perceives or accepts the intended benefits of writing a master's thesis, for instance. Not every teacher educator conducts research, nor seems to appreciate the principle of being a 'wise consumer' of educational research. The theory and practice by no means always meet each other in the reality.

Teacher education in Finland, with Åbo Akademi university as the case study, has been described and analysed from the point of view of educational science. It is necessary, finally, to point out that the research based approach is not only restricted to specific courses in research methodology and thesis writing. The teacher education programme as a whole is designed to integrate the research culture into the practice. It is evident that the context and origins of problems, prospects and measures to be carried out can be interpreted in different ways. 'Insider' views, despite being subjective, will be of value in offering the opportunity of systematically comparing conditions of teacher education in one country with those in other countries.

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Epistemologies, beliefs and conceptions of mathematics teaching and learning: the theory, and what is manifested in mathematics teachers' work in England, France and Germany

Abstract

This paper firstly explores the issues raised in the literature concerning epistemologies, beliefs and conceptions of mathematics and its teaching and learning. Secondly, it analyses the ways in which mathematics teachers' classroom practices in England, France and Germany reflect teachers' beliefs and conception of mathematics and its teaching and learning. Drawing on a recent study of mathematics teachers' work in England, France and Germany, the findings suggest that teachers' beliefs and conceptions are manifested in their practices and can be traced back to philosophical traditions of the three countries, to epistemological and educational trends of mathematics and mathematics education, and to personal constructions. It is suggested that teachers' pedagogical styles are a personal response to a set of assumptions about the subject and its teaching and learning, to a set of educational and philosophical traditions, and to a set of institutional and societal constraints. Thus, it is argued that teachers' pedagogies need to be analysed and understood in terms of a larger cultural context and in relation to teachers' conceptions and beliefs, and that a lack of such understanding is likely to inhibit the process of change at all levels of the system.

Introduction

One's conceptions of what mathematics is affects one's conception of how it should be presented. One's manner of presenting it is an indication of what one believes to be most essential in it. … The issue, then, is not, What is the best way to teach? But, What is mathematics really about? (Hersh 1986, p.13)

This quote indicates that what teachers might consider to be desirable ways of teaching and learning of mathematics rests, to a large extent, on their epistemologies, beliefs and conceptions of mathematics. Thom (1973) noted that 'all pedagogy, even scarcely coherent, rests on a philosophy of mathematics' (p.204). This philosophy that every teacher constructs for him/herself is likely to be influenced by the epistemologies of mathematics and mathematics education, and by each one's beliefs and conceptions of mathematics and its teaching and learning.

The literature on teaching and learning has given attention to the conditional or situational factors that shape or colour teachers' (and pupils') educational experience in mathematics classrooms (for example, Cole 1990). Within any country and educational community, these factors appear in many forms (for example, physical resources), and they are recognised to be influential. Embedded in the context are the values, beliefs and traditions of a particular education system which may be manifested

in adopted curricula, educational practices, in systemic features such as pupil organisation, in expectations of students, parents, colleague teachers and administrators, for example.

Yet, many of the conditions that exert influence on human thought and practice within classrooms are neither visible nor readily identifiable. Rather, these forces are the unseen, sometimes 'unperceived', and often unvoiced principles, philosophies and beliefs that unwittingly penetrate the educational enterprise. For example, Lortie (1975) asserts that teachers' pedagogical practice, in particular in the early stages of their professional lives, is to a large extent influenced by their own schooling years and during thousands of hours of an 'apprenticeship of observation' (Lortie 1975). It is likely that each country gives its teachers and students a different 'apprenticeship of observation', which is underpinned by the educational trends and traditions of that particular country. Thus, there exists a complex relationship of forces with many sources of influence at work. One of the quiet but powerful frameworks is the epistemological beliefs and conceptions that teachers (and students) hold. Indeed, the community of educational researchers is becoming increasingly aware of the potential impact that teachers' beliefs about mathematical knowledge and education have on their classroom practice (Ernest 1988), how they approach the subject they are teaching (Anders and Evans 1994), and interact with their students (Lampert 1990).

In order to understand the complexities of the issue, but at the same time not to lose the rich details of the research, we have chosen to look at the ways in which mathematics teachers' beliefs and conceptions are manifested in educational practices in England, France and Germany. In the first part of the paper epistemologies, beliefs and conceptions of mathematics and its teaching and learning are discussed as the literature present them. This includes the distinctions and links between epistemologies, beliefs and conceptions, and the main ideas reviewed from the literature. In the second part the empirical data and results from the study of mathematics teachers' work (Pepin 1997) are explored and discussed.

Epistemologies, teachers' beliefs and conceptions

Epistemology is generally concerned with 'the theory of knowledge', especially the critical study of its validity, methods and scope (Hanks *et al.* 1986; Sierpinska and Lerman 1996). Because of the close connection that exists between beliefs and knowledge, distinctions between them have been difficult to identify and fuzzy (Scheffler 1965). Because it had been noted that teachers frequently treat their beliefs as knowledge, this led researchers who investigated teachers' knowledge also to consider teachers' beliefs (Grossman *et al.*, 1989). Indeed, some educationists have argued that it is not useful for educational researchers to search for distinctions between knowledge and belief, but rather to search for whether and how, if at all, teachers' beliefs (or what they may take to be knowledge) affect their practices (Thompson 1992). Mathematics educators are generally interested in 'explaining the processes of growth of mathematical knowledge' and 'in observing and explaining the processes of mathematical discovery in the making, both in mathematicians and in students' (Sierpinska and Lerman 1996). Ultimately, as practitioners, they are interested in researching ways of provoking such processes in teaching.

Nevertheless, for the argument in this paper it is important to briefly refer to the distinctions, if there are, between beliefs and knowledge (as knowledge are the basis for epistemologies). A common stance among philosophers is that disputability is associated with beliefs; truth or certainty is associated with knowledge (Scheffler 1965).

Thompson (1992) asserts that :

from a traditional epistemological perspective, a characteristic of knowledge is general agreement about procedures for evaluating and judging its validity; knowledge must meet criteria involving canons of evidence. Beliefs, on the other hand, are often held or justified for reasons that do not meet those criteria, and, thus, are characterised by a lack of agreement over how they are to be evaluated or judged. (p.130)

Nespor (1987) argues that:

Belief systems often include affective feelings and evaluations, vivid memories of personal experiences, and assumptions about the existence of entities and alternative worlds, all of which are simply not open to outside evaluation or critical examination in the same sense that the components of knowledge systems are. (p.321)

However, over time, 'old theories' are often replaced by 'new ones'. Indeed, within the philosophy of science it is commonly accepted that what is referred to as 'factual' knowledge is dependent upon current theories (Lakatos 1976; Kuhn 1962). Thus, what may have been regarded as knowledge at one time, may be judged as belief at a another time. Or, once-held beliefs may, in time, be accepted as knowledge in the light of supporting evidence and theories. Thus, there is a temporal quality of theories as canons of evidence (Sierpinska and Lerman 1996). Furthermore, in education there are co-existing and alternative theories that explain the processes in teaching and learning. This may help to explain the difficulty of distinguishing between teachers' knowledge and beliefs.

Another point to make is about beliefs and belief systems. The notion of belief systems is a metaphor for examining and describing how an individual's beliefs are organised (Green 1971). As such, they can be conceived of as a cognitive structure, and as dynamic in nature, thus restructuring as individuals change and evaluate their beliefs against their experiences. Green (1971) identified three dimensions of belief systems in the way in which they are related to one another. These dimensions are related to, firstly, the notion that beliefs are not held in total independence of all other beliefs; secondly, to the degree of conviction with which beliefs are held; and, thirdly, to the notion that beliefs are held in clusters (in Thompson 1992).

In addition, there is the notion of conceptions. This is seen here as a more general mental structure, encompassing beliefs, meanings, concepts, for example (Thompson 1992). Thus, though the distinction between conceptions and beliefs might not be distinguishably important, it will be more 'natural' at times to refer to teachers' conceptions of mathematics (as a discipline) than to speak about their beliefs about mathematics.

Philosophical traditions

Whilst acknowledging the influence of epistemologies, beliefs and conceptions of mathematics and its teaching and learning, there are other powerful influences that underpin, arguably, teachers' work. These influences stem from the country's philosophical school knowledge traditions. They permeate and underlie the individual national systems and influence, to a greater or lesser extent, teachers' thinking and decision-making and thus their pedagogies (principles and practices) in English, French and German classrooms (Pepin 1997). In this section the underpinning educational traditions of England, France and Germany (McLean 1990) are briefly explained.

The main underpinning philosophy of the English education system is humanism, with its associated principles of individualism and morality, amongst others. English education is said to be child-centred and individualistic, and the interaction between teacher and pupil is greatly emphasised. With respect to morality, there was (and is) the belief that education (originally only for the elite)

should develop qualities such as fairness and integrity, and teachers have traditionally had a pastoral as well as an academic function. The teacher has traditionally been responsible not only for the academic but also for the moral development of the child. Thus, individualism and the moral purpose of education are two of the traditional signposts for the philosophical underpinning of the English education system. One of the claims about humanism is that it is anti-rational and that England has in the past given 'little weight in education to rational, methodical and systematic knowledge objectives' (Holmes and McLean 1989). This can be understood in the light of the philosophy of humanism which assumes that to acquire knowledge is not a logical, sequential and standardised process, as rationalists would claim, but that learning is regarded as 'intuitive'. The acquisition of knowledge was the outcome of the interaction between the inherent qualities of the learner and different materials appropriate to the student's development. Therefore, the content of education should be selected in the light of individual differences.

There are two features in the philosophy of French education which help in understanding the system and the practices of those who work within it. Firstly, France is seen as one of the heartlands of encyclopaedism, with its main principles of rationality and universality, and the associated principle of *égalité*, transforming society in the interests of the majority of its members. The principle of rationality encourages the teaching of subjects which are perceived to encourage the development of rational faculties (for example, mathematics). The principle of universality means that students study broadly the same curriculum (at broadly the same time). The associated egalitarian views aspire to remove social inequalities through education and promote equal opportunities for all pupils. Secondly, the principle of *laïcité* traditionally leaves the social and moral education for the home environment, whereas intellectual and academic work is expected to be placed in school. Thus traditionally, teachers have been responsible for the academic development of the child, the parents and the church for their moral development. However, this has been changing in the sense that changes in the social role of families have transferred a socialising function to schools.

Germany espouses mainly humanistic views, based on Humboldt's ideal of humanism, combined with naturalistic tendencies. Humboldt's concept of *Bildung* searches for 'rational understanding' of the order of the natural world. It incorporates encyclopaedic rationalism as well as humanist moralism, and basically promotes the unity of academic knowledge and moral education. Therefore, teachers have traditionally held the two functions, that of academic specialist and, possibly to a lesser extent, that of moral educator. However, the humanist rationale was never allowed to avoid the importance of the study of mathematics and science subjects. The naturalistic view, in the German sense, combines the child-centred approaches with the work-orientated. The 'wholeness' of education emphasised the belief that educative experiences are not necessarily intellectual. In Germany there is the cultural view that every occupation has dignity and that work of every occupation should be carried out with maximum commitment and thoroughness.

Epistemologies of mathematics education

Whilst it is recognised that epistemologies of mathematics had an important influence on epistemologies of mathematics education, in this paper they are left largely untouched. However, because of their influence on mathematics education, there are some important works that have to be mentioned. For example, in France works of Brunschwicg (1912) and Poincaré (1908) were important influences for the works of Bachelard (1938), Piaget (1972) and Dieudonné (1992). Dieudonné, one of the founders of the Bourbaki group, viewed mathematics as a unified whole, in which the meaning and significance of every part is a function of the role it plays in this whole. These ideas found their way into mathematics education at large in the sixties in the 'Modern maths' reforms (see Moon 1986).

The works of Wittgenstein (1974) and Lakatos (1976) also influenced mathematics education, perhaps unintentionally, in the sense that heuristics were, so they claim, the essence of mathematics, not the outcomes. Previously, mathematics was identified as a particular body of knowledge, a subset of which is deemed appropriate for school students and a somewhat larger subset for those who may go into higher education. The move to heuristics, which regards the doing of mathematics as the pivotal characteristic of the subject (rather than its content) encouraged problem solving and investigational work as a major focus of school mathematics since the 1970s. This manifested itself by the growth of problem solving and investigational activities in schools by teachers in such groups as the Association of Teachers of Mathematics (ATM) in the UK. As an approach to the teaching of mathematics it was established by academics such as Mason *et al.* (1984), and as a view of mathematical knowledge by writers such as Lerman (1986), or Ernest (1991), for example.

Turning to epistemologies of mathematics education, there is a basic difference in the viewpoint (compared to the epistemology of mathematics), because mathematics education deals not only with the possible worlds of mathematics itself (as subject matter) but also with the actual minds of students and teachers, which are embedded in a socially complex world of the nation's education system and the educational institution. Whilst the theories of mathematical knowledge belong to an established science, mathematics education was in need of a generic epistemology and theory of its field of scientific enquiry. These needs are reflected in the interpretations that mathematics educators and researchers have been making of Piaget's constructivist epistemology, and other epistemological views. In the following sections we shall review some of those interpretations.

There are basically four directions that help us to understand the field: psychometrics; constructivism; socio-cultural views; and interactionist views. A fifth field could be the French *didactique*.

Psychometrics

Historically, before the 1960s almost all educational research was within the discipline of psychology. In mathematics education and within this psychometric paradigm, pupils were considered to possess differing amounts of a number of traits (different 'abilities') which in turn allowed pupils' intelligence to be measured by testing (Spearman 1972). A radical change took place between 1950 and 1970 when Piaget's work was translated into English. The effect was particularly strong in mathematics education, because some of his works focused on logical and mathematical thinking (Piaget 1952). This shifted the focus from psychometrics to developmental cognitive psychology (although strictly speaking, and Piaget himself admitted to it, his work was in the area of generic epistemology (of mathematics) rather than educational psychology or mathematics education). In Britain there were a number of profound changes within teacher education, and subsequent curriculum changes (for example, Nuffield Mathematics Project), which led to changes in how mathematics was presented first in primary schools, and later in secondary schools.

Constructivism

From the constructivist point of view, there are no direct connections between teaching and learning, since the teacher's knowledge cannot be conveyed to the students, the teacher's mind is inaccessible to the students and vice versa. This supports the notion that pupils actively construct their own learning through assimilation and accommodation of cognitive structures, a process which is influenced by the experiences of the pupil, but is dependent upon whether the existing nature of structures is such as to allow the concepts to be acquired. Within constructivism some now nearly independent strands have developed: social constructivism; and radical constructivism.

Social constructivists argue for a process of enculturation, separate from and in addition to the child's constructions. Cobb (1989) claims that children's mathematical constructions are 'profoundly

influenced' by social and cultural conditions. Bauersfeld (1995) suggests that 'the core part of school mathematics enculturation comes into effect on the meta-level and is 'learned' indirectly'. Vygotsky also focused on the role of language in learning, thus introducing the discipline of linguistics and mathematical communication into mathematics education research (see for example, Pimm 1987, Durkin and Shire 1991). Vygotsky's work is further discussed under 'socio-cultural views' (see below).

For *radical constructivists*, the first principle is that the teacher recognises that s/he is not teaching students about mathematics, s/he is 'teaching them how to develop their cognition' (Confrey 1990, p.110), and that s/he is 'a learner in the activity of teaching' (Steffe and D'Ambrosio 1995, p.146). Thus, and as von Glasersfeld put it, teaching is 'a task of inferring models of the students' conceptual constructs and then generating hypotheses as to how the students could be given the opportunity to modify their structures so that they lead to mathematical actions that might be considered compatible with the instructor's expectations and goals' (von Glasersfeld 1990, p.34). At the level of groups of students, Steffe and D'Ambrosio (1995) describe constructivist teaching as interacting with students in a learning space whose design is based, at least in part, on a working knowledge of students' mathematics. This learning space consists of three elements: the posing of situations; the encouragement of reflection; and interactive mathematical communication.

Socio-cultural views

This label is given to theories which espouse the view that the individual is situated within cultures and social situations such that it makes no sense to speak of the individual or of knowledge unless seen through context or activity. Knowledge is cultural knowledge taken as socially produced, bound up with social values and socially regulated. Referring back to the epistemologies of mathematics, it is only relatively recently, and following Lakatos (1976), that mathematics has been accepted, not as a universal body of knowledge independent of local cultures, but as itself a social construction (see also a comprehensive review of differing ideologies in the philosophy of mathematics by Ernest 1991).

There has been growing interest in and focus on the social context of the mathematics classroom (for example, Bishop 1988; Keitel 1989; Lerman 1994). What is of current interest is a move away from the identification of social factors as the realm of the affective to a concern with the part that the social and cultural environment plays as a whole in the development of the child. In terms of knowledge this moves away from 'knowledge a priori', and also away from 'knowledge as it is individually constructed' to 'knowledge as socially constructed and justified' (Sierpinska and Lerman 1996). Lave (1988) developed a notion of knowledge-in-action in contrast to a cognitive perspective, and located mathematics in various contexts in which people act (everyday and workplace situations), but she did not engage in any depth with pedagogical issues. Vygotsky, on the other hand, was centrally concerned with learning (and teaching). Being influenced by Marxist theories, he regarded consciousness (and thus the individuals who compose it) as a product of time and space, and in particular of one's cultural situation. Vygotsky's concern was with the nature of consciousness and its development. For him, communication drove consciousness, and the process of learning was integral to communication. The psychology of the individual, consciousness, is formed through the mediation of tools, which are in themselves expressions of the socio-historical-cultural situation. This brings subject and object together, and new knowledge and knowledge structures lead to a shift of the 'world'.

Vygotsky (1978) identified the 'zone of proximal development' which is the difference between what a child can do on her/his own and what s/he can do with the aid of a more experienced peer/adult/teacher. The child is assisted through a process which lies in the student's 'zone of proximal

development' until the 'scaffolding' can be removed and the child can act alone. This is a fundamental shift in the sense that all learning is viewed as taking place with others. The theory that 'learning leads development' stands in direct contrast to the writings of Piaget for whom development, in the form of the child's stages of development, led learning. Whilst the Piagetian model is based on the 'lone learner', the learners construct their own understanding, social constructivism claims that the role of the teacher (or parent/peer) is crucial in 'scaffolding' the learning.

Another fundamental feature of Vygotsky's theories was the process of internalisation. 'The process of internalisation is not the transferral of an external to an … internal plane of consciousness, it is the process in which this plane is formed' (Leont'ev 1981, p.57). Thus, there is unification of teaching and learning.

Interactionist views

In this paradigm interactions are not regarded as mere auxiliary and helpful factors of development, but interactions and development are seen as inseparable. The focus of study is not the individual but interactions between individuals within a culture (Bruner 1985). Language (and 'languaging') becomes very important, which is seen as the 'active moulder of experience' and not a 'passive mirror of reality' (Bauersfeld 1995). Wittgenstein is often quoted saying that 'speaking of language is … a form of life' (cited in Bauersfeld 1995).

For an interactionist mathematics educator, learning is not just an endeavour of the individual mind trying to adapt to an environment, nor can it be reduced to a process of enculturation into a pre-established culture. In the mathematics classroom, the individual construction of meanings takes place in interaction with the culture of the classroom while at the same time it contributes to the constitution of this culture (Cobb and Bauersfeld 1995, p.9). This property is called 'reflexivity' which is quite central to interactionist approaches.

In this approach meanings are elaborated through negotiations whereby the group comes to agree on certain conventions in the interpretation of signs, situations, and behaviours. Through this interaction, the individual contributions may add up to something nobody in particular has thought about and anticipated (Voigt 1995). An important issue is that people learn indirectly, through participating in a culture and its discursive practices. For example, pupils learn what counts as mathematical thinking by observing what is addressed and what kind of solutions are distinguished by the teacher and other students as 'simple' or 'non-acceptable'.

The view on language is different from the previously discussed paradigms. For Piaget, language is an expression of thought, for Vygotsky a medium of cultural transmission. Interactionism ceases to see language as a separate object (tool) that can be used for one purpose or another, but they regard language as creating a reality, 'languaging' (Bauersfeld 1995). Relating to this, mathematics is seen a special type of discourse, where discourse is interpreted as 'language-in-action', a 'vehicle for doing things with and to others' (Bruner 1985). Thus, mathematics becomes a way of seeing the world and thinking about it.

Moreover, the process of construction of knowledge is based on interpretations that have their source not in the individual alone but in his/her interpretation with others within a culture. Constructivism is the point of view of the individual as s/he makes sense of the world, interactionism is the point of view of an observer of the social life, and looks at people sharing meaning and at the functioning of language as it creates meanings. For Bauersfeld, and according to interactionism, meanings are generated neither by the individual minds nor are they attributed to some historically founded 'collective mind' of a society, but they are continually constituted in interactions whose

patterned character accounts for the relative stability of cultures. Bauersfeld (1995), in rehabilitating some of the 'old-fashioned' values in education, has stressed the role of the quality of the culture in which one lives for personal upbringing. He reminds researchers that imitative learning 'is the most common form of learning in a culture' (p.283). Thus, the role of the teacher becomes paramount in the educational process.

French 'Didactique'

Since the mid-seventies mathematics educators have devoted much time in their work on the epistemology of mathematics education and on the nature of that knowledge involved in mathematics education. French research on 'didactique des mathématiques', the issue of preparing mathematics for students, can be broadly divided into two not independent but nonetheless distinct theoretical fields: the field of 'didactical transposition' developed by Chevellard (1991, 1992); and the theory of 'didactical situations' initiated by Brousseau (1986).

The theory of didactical transposition concentrates on the analysis of those processes that are based on reference knowledge, in particular the processes involved when transposing 'scholarly knowledge' (savoir savant) to that of 'taught knowledge' (savoir enseigné). It is assumed that there exists some identifiable knowledge called 'savoir savant mathématique', against which the mathematics taught in schools could be judged or 'legitimised'. Another assumption of didactic transposition is that what is taught will ultimately be learnt by students, and that there is some expert knowledge. These notions are foreign from a constructivist point of view, in the sense that there is no knowledge existing outside individuals' minds, and thus no distinction between expert and novice knowledge. There has been much criticism of the vagueness of the notion of 'savoir savant' (Freudenthal 1986), which created a response to it. It is argued that society recognises the existence of a group of professionals who produce knowledge which is considered as 'knowledgeable' (savant). More recently Chevellard (1991) looked at relations between the social practice of research in mathematics and social practice of institutionalised teaching and learning of mathematics at school. He subsequently extended his theory and assumed that all knowledge is knowledge of an institution.

Brousseau's (1986) theory, the theory of didactical situations, is situated at a more local level. It aims to model teaching situations so that they can be developed and managed in a controlled way. At the basis of this theory is the assumption that 'knowledge exists and makes sense for the cognising subjects only because it represents an optimal solution in a system of constraints' (p.368). According to Artigue (1994) it is based on a constructivist approach and operates on the principle that knowledge is constructed through adaptation to an environment that appears problematic to the student. Von Glasersfeld (1995) writes:

From the constructivist perspective, as Piaget stressed, knowing is an adaptive activity. This means that one should think of knowledge as a kind of compendium of concepts and actions that one has found to be successful, given the purposes one has in mind. (p.7)

Brousseau's theory aims to become a theory for the control of teaching situations in their relationship with the production of mathematical knowledge. The didactic systems are therefore made up of three mutually interacting components: the teacher, the student, the knowledge. The aim is to develop the conceptual and methodological means to control the interacting phenomena and their relation to the construction and functioning of mathematical knowledge in students.

The basic assumption of Brousseau's theory of situations is that knowledge constructed or used in a situation is defined by the constraints of this situation, and that, therefore, by creating certain artificial constraints the teacher is able to provoke students to construct a certain type of knowledge.

Teachers' beliefs and conceptions

In response to the question 'What is mathematics?' Hersh (1986) offers the following answer:

Mathematics deals with ideas. Not pencil marks or chalk marks, not physical triangles or physical sets, but ideas (which may be represented or suggested by physical objects). What are the main properties of mathematical activity or mathematical knowledge, as known to all of us from daily experience? (1) Mathematical objects are invented or created by humans. (2) They are created, not arbitrarily, but arise from activity with already existing mathematical objects, and from the needs of science and daily life. (3) Once created, mathematical objects have properties which are well-determined, which we may have great difficulty discovering, but which are possessed independently of our knowledge of them. (pp.22–23)

Hersh here adopts the idea of the practising mathematician and, in line with other philosophers such as Lakatos (1986), challenges the basic assumption that mathematical knowledge is a priori and infallible. An assumption underlying Hersh's view of mathematics is that *knowing* mathematics is *making* mathematics, its creative activities and processes. This view of mathematics is reflected in documents such as The Cockcroft Report (Committee of Inquiry into the Teaching of Mathematics in Schools, 1983) in England, for example. The conception of mathematics teaching that is reflected in this document is one in which students engage in purposeful activities that grow out of a problem situation, requiring reasoning and creative thinking, gathering and applying information, discovering, inventing, and communicating ideas, and testing those ideas through critical reflection and argumentation. This view of mathematics teaching is in sharp contrast to alternative views in which the mastery of concepts and procedures is the ultimate goal of instruction, although it does not deny the value of concepts and procedures in the mathematics curriculum. The National Council of Teachers of Mathematics (NCTM, 1989) writes that 'instruction should persistently emphasise "doing" rather than "knowing that"' (p.7).

The nature of teachers' beliefs about the mathematics and its teaching and learning, as well as the influence of those beliefs on teachers' classroom practices, are relatively new areas of study. A number of studies in mathematics education (for example, Lerman 1983; Thompson, 1984) have suggested that teachers' beliefs about mathematics and its teaching and learning significantly influence the 'modelling' of teachers' characteristic pedagogies. Ernest (1988) noted that among the key elements that influence teachers' practices, three are most influential: (1) teachers' system of beliefs concerning mathematics and its teaching and learning; (2) the social context of the teaching situation (constraints, opportunities, etc.); (3) teachers' level of reflection (p.1). He contends that the research literature on mathematics teachers' beliefs indicate that teachers' approaches to mathematics teaching depend basically on their systems of beliefs (in particular on their conceptions of the nature of mathematics) and on their mental models of teaching and learning mathematics.

Thompson (1992) views a teacher's conception of the nature of mathematics as 'that teacher's conscious or subconscious beliefs, concepts, meanings, rules, mental images, and preferences concerning the discipline of mathematics' (p.132), which constitute the rudiments of a philosophy of mathematics. Ernest (1988) distinguished three conceptions of mathematics:

First of all, there is a dynamic, problem-driven view of mathematics as a continually expanding field of human creation and invention, in which patterns are generated and then distilled into knowledge. Thus, mathematics is a process of enquiry and coming to know, adding to the sum of knowledge. Mathematics is not a finished product, for its results remain open to revision (the problem-solving view).

Secondly, there is the view of mathematics as a static but unified body of knowledge, a crystalline realm of interconnecting structures and truths, bound together by filaments of logic and meaning. Thus, mathematics is monolith, a static immutable product. Mathematics is discovered, not created (the Platonist view).

Thirdly, there is the view that mathematics, like a bag of tools, is made up of an accumulation of facts, rules and skills to be used by the trained artisan skilfully in the pursuance of some external end. Thus, mathematics is a set of unrelated but utilitarian rules and facts (the instrumentalist view). (p.10)

Lerman (1983) identified two alternative conceptions of the nature of mathematics, which he named 'absolutist' and fallibilist', and which, according to him, correspond to two competing schools of thought in the philosophy of mathematics: Euclidean and Quasi-empirical (Lakatos 1978). From the absolutist perspective, mathematics is based on universal and 'true' foundations, and as such is 'the paradigm of knowledge, certain, absolute, value-free, and abstract'. From the fallibilist perspective mathematics develops through conjectures, proofs and refutations, and uncertainty is inherent in the discipline (Lerman 1983). There are obvious parallels between Lerman's absolutist and fallibilist views and Ernest's platonic and problem-solving views.

Skemp (1978) proposed that two conceptions of mathematics account for sharp differences in classroom practices and emphases: 'relational mathematics' and 'instructional mathematics'. According to Skemp, instrumental knowledge of mathematics is knowledge of a set of 'fixed' plans for performing mathematical tasks (step-by-step procedure), whereas relational knowledge of mathematics is characterised by the possession of conceptual structures that enable the teacher/ pupil to construct several plans for performing a given task.

Teachers' conception of mathematics teaching and learning

Whilst differences in teachers' conceptions of mathematics appear to be related to differences in their views about mathematics teaching, teachers' conceptions of mathematics teaching are also likely to reflect their views of how students learn mathematics and of students' mathematical knowledge (Carpenter *et al.* 1988). There seems to be a logical, natural connection between teachers' teaching 'models' and their underlying theories of how students learn mathematics. However, the literature claims that for most teachers the two have not developed into a coherent theory of instruction. Clark (1988) suggested that conceptions of teaching and learning tend to be eclectic collections of beliefs and views that appear to be more the result of their years of classroom experience than any type of formal approach. He says:

Research on teacher thinking has documented the fact that teachers develop and hold implicit theories about their students…, about the subject matter that they teach … and about their roles and responsibilities and how they should act … These implicit theories are not neat and complete reproductions of the educational psychology found in textbooks or lecture notes. Rather, teachers' implicit theories tend to be eclectic aggregations of cause-effect propositions from many sources, rules of thumb, generalisations drawn from personal experience, beliefs, values, biases, and prejudices. (p.6)

In studying the source of teachers' beliefs about teaching and learning, it has been noted that those beliefs are, to a large extent, formed during teachers' schooling years and are shaped by their own experience as pupils. Teachers have spent thousands of hours in an 'apprenticeship of observation' (Lortie, 1975) which is likely to lead to the development of a body of values, commitments, orientations and practices. The literature suggests that these established values and orientations persist despite the efforts of training institutions (Lacey 1977; Haggarty 1995).

In terms of models of mathematics teaching, Kuhs and Ball (1986) identified 'at least four dominant distinctive views of how mathematics should be taught':

1. *Learner-focused*: mathematics teaching that focuses on the learner's personal construction of mathematical knowledge;
2. *Content-focused with an emphasis on conceptual understanding*: mathematics teaching that is driven by the content itself but emphasises conceptual understanding;
3. *Content-focused with an emphasis on performance*: mathematics teaching that emphasises student performance and mastery of mathematical rules and procedures; and
4. *Classroom-focused*: mathematics teaching based on knowledge about effective classrooms. (p.2)

The *learner-focused* view of mathematics teaching is underpinned by a constructivist view of mathematics learning (von Glasersfeld 1987). From this perspective of teaching, the teacher is viewed as facilitator and stimulator of pupil learning. Students are ultimately responsible for judging the appropriateness of their own ideas. The *content-focused with emphasis on understanding* is the view that follows from the Platonic view (Ernest 1988) of the nature of mathematics. This view of teaching emphasises students' understanding of the logical relations among various mathematical ideas and the concepts and logic underlying mathematical procedures. In this model the content is organised according to the structure of mathematics, and students' ideas and interests are of secondary importance. The *content-focused view with emphasis on performance* is described by some (for example, Brownell 1935) as 'drill theory'. This view would follow from the instrumentalist view of the nature of mathematics, and the content is organised according to a hierarchy of skills and concepts. From this perspective, the role of the teacher is to demonstrate, explain and present the content in an expository style, and that of the pupils to listen, participate and do exercises that have been set by the teacher. Central to the fourth view is the notion that classroom activity must be well-structured and efficiently organised. The assumption here is that students learn best when the lessons are clearly structured and the teacher follows principles of effective instruction.

Ernest (1991) identified five categories of educational ideologies of mathematics education: 'industrial trainer'; 'technological pragmatist'; 'old humanist'; 'progressive educator'; and 'public educator'. Briefly, for the 'industrial trainer' mathematics is a 'clear body of knowledge and techniques'. His/her theory of mathematics teaching is authoritative and teaching is seen as 'passing on a body of knowledge' (Lawlor 1988, p.9, in Ernest, 1991). According to the 'technological pragmatist's' ideology of mathematics education, knowledge has two parts: pure mathematical skills, procedures and facts; and applications and uses of mathematics. The theory of mathematics learning associated with this theory is comparable to an apprenticeship in the sense that knowledge and skills are acquired through practical experience. The 'old humanist' regards mathematics as a 'pure, hierarchically structured' body of objective knowledge. The teacher's role is that of 'lecturer and explainer', communicating the structure of mathematics meaningfully. Within the theory of the educational ideology of the 'progressive mathematics educator', mathematics is 'a vehicle for developing the whole child', where the emphasis is not the curriculum but the child. Ernest asserts that 'the process of mathematical problem-solving and investigating, such as generalising, conjecturing … figure more prominently than specification of mathematical content. The teaching of the subject consists of encouragement, facilitation, and the arrangement of carefully structured situations for investigation. For the 'public educator', school mathematics must reflect mathematics as a social construction, and therefore not be seen as alienated from the student's world. Mathematical knowledge is expected to provide 'an understanding of and power over both the abstract structures of knowledge and culture, and the mathematised institutions of social and political reality'. The teaching of mathematics includes a number of components:

1. 'Genuine discussion, both student-student and student-teacher, since learning is the social construction of meaning;

2. Co-operative groupwork, project work and problem solving, for confidence, engagement and mastery;
3. Autonomous projects, exploration, problem posing and investigative work, for creativity … and engagement through personal relevance;
4. Learner questioning of course content, pedagogy and modes of assessment used, for critical thinking; and
5. Socially relevant materials, projects and topics, including race, gender and mathematics, for social engagement and empowerment.' (pp.208, 209, Ernest 1991)

Relationship between beliefs about teaching and instructional practice

The literature suggests that teachers' conceptions of teaching and learning mathematics are not related in a simple cause-and-effect way to their instructional practices. The relationship is not a simple one. Yet, an assumption that appears to underlie many investigations is that the relationship is one of linear causality, where first come the beliefs and then follows the practice. The literature suggests that the relationship is more complex, involving a give and take between beliefs and experience and thus is dialectical in nature. (Thompson 1992). There exists a complex relationship with many sources of influences at work. For example, one such source is the social context in which mathematics teaching takes place. Embedded in this context are the values, beliefs and expectations of students, parents, colleague teachers and administrators, perhaps the adopted curriculum, the educational practices of assessment and pupil organisation, and the values and philosophical leanings of the educational system at large.

Findings

The research that forms the basis of the empirical work reported in this paper (Pepin 1997) sought to develop an understanding of mathematics teachers' work at secondary level in three European countries: England, France and Germany. The original question underlying the study was whether it would be possible for mathematics teachers at secondary level in England, France and Germany to work in a country other than their own (Pepin, 1999b). Twelve mathematics teachers, four in each country, were 'shadowed' for two weeks each, in order to develop an understanding of their beliefs concerning teaching and learning, and their classroom practices. The work was carried out within the framework of an ethnographic approach, in combination with stimulated recall, in order to explore the context in which teachers were working; and how they conceived of and carried out their tasks in schools. Five theoretical conclusions were generated from the study. Those theories were concerned with commonalities amongst mathematics teachers in the three countries; with the influence of cultural educational traditions on teachers' pedagogies (Pepin, 1999a); with the influence of varying ranges of teachers' tasks and responsibilities on their beliefs and practices (Pepin 1998); with terms and conditions under which teachers work with respect to people in the wider community; and with the influence of teachers' different beliefs about mathematics on their practices.

The latter theoretical conclusion is the focus of this paper. Firstly, findings on teachers' perceptions of the nature of mathematics are discussed. Secondly, it is argued that teachers' beliefs and conceptions of mathematics and its teaching and learning are manifested in their practices, and the practices encouraged in textbooks.

Perceptions of mathematics

Not all teachers chose to talk about the nature of mathematics in an explicit way. Some explained their views on mathematical reasoning, rigorous proof and mathematical expressions, which in turn gave the researcher indications of their beliefs and conceptions concerning the nature of mathematics.

There were three lines of perception about the nature of mathematics: mathematics as a tool; as 'training the mind' with its logic; and as a criterion for selection.

Most teachers who chose to comment on the nature of mathematics explicitly saw it as a tool or utensil (at the 11–16 age level). Some English teachers pointed to the 'skill side', mathematics as a tool for other subjects, which was also reiterated by German and French colleagues.

From what teachers mentioned concerning mathematical reasoning, it was clear that they also acknowledged the more transcendent nature of it ('training of the mind') and that it had a high priority in their view. German and, more particularly French, teachers felt that logic was the principal element of mathematics, and their classroom practice reflected these beliefs. In England, curiously, there were inconsistencies between what English teachers said and what they did in the classroom. Although English teachers talked about logic and reasoning quite extensively, they rarely practised it in their classrooms. The English teachers all mentioned logic and reasoning, the development of the mind through logical ways of thinking, as part of the nature of mathematics. This was surprising to the researcher, because in none of the lessons observed did the researcher see an emphasis on logical reasoning. Teachers seemed to assume that logical skills would be learnt from activities, such as investigations where reasoning was asked. Furthermore, the researcher speculates that teachers were interested in results (the piece of course work) and not in the process of how pupils discovered, investigated or their reasoning. For example, when commenting on course work and investigations, one teacher explained that pupils did their investigations (investigational tasks for course work) 'under exam conditions'. In her opinion it was 'nicely organised', it was 'cut and dried' and 'finished' within a reasonable time.

This suggested that there was a inconsistency between some English mathematics teachers' view of the nature of mathematics and its manifestation in their practices. One possible explanation could be that teachers themselves were educated in mathematics to give reasons for what they did, but in school, with time constraints and a busy working schedule, found it hard to comply with their own expectations. Another explanation would be that for them it was not worth emphasising the logic for most pupils and only appropriate for the most able. However, they did not mention this dichotomy in any way, and it is speculated that English teachers were not critical of this aspect of their work.

Regarding mathematical expression, some English teachers did not view formal mathematical notation or expressions as a means by which to educate their pupils to think in a logical way. They tried to adjust their vocabulary to pupils' level of understanding. One teacher commented that she tried 'to work out what language (was) useful' for pupils' understanding. In terms of mathematics notation, her colleague believed that 'the idea of being lazy as a reason for mathematical notation' was 'one that the kids (could) generally connect to' (in the sense of not writing a lot of words, but rather expressing it in a simple way).

One German teacher chose to talk about the nature of mathematics explicitly. He differentiated between the pure side of mathematics (the logic) and the tool side of it (as utensil for other sciences) which was regarded by him as the basis and which the teacher of his school form (*Hauptschule*) had to deal with most of the time. His colleague working in the *Gymnasium* emphasised that the subject material should be prepared in such a way that it was 'orientated' towards 'logic' and she regarded it as 'correct' to treat a topic in an 'abstract' way. This indicated that German teachers of both school forms considered logic as the principal element of mathematics, and they tried to include it into their practices.

Some French teachers perceived mathematics as a criterion for selection (for further education or jobs, for example), others regarded it as a tool or utensil in science, for example. But they all

emphasised that there was another side to it, with something of a 'transcendent' nature, and one teacher summed it up by saying that the logical reasoning in mathematics served as 'training of the mind'. In France, rigorous proof was part of the curriculum in years 9 and 10 and one teacher commented that the 'aim' of rigorous proof was 'logical thinking'. From the ways teachers conducted their lessons and the type of exercises they provided, the emphasis on justification and proof in the curriculum documents and from the interview with the inspector, the researcher concluded that in France logical reasoning was regarded as the main element of mathematics, in practice as well as in theory.

Teachers' beliefs on the nature of mathematics are manifested in their practices and they are different in the three countries

This section is concerned with teachers' beliefs and conceptions of mathematics teaching and learning. It is argued that teachers had different views about the nature of mathematics, the aims of teaching mathematics and the ways it could be learnt, which were manifested in their practices. In the first instance, teachers' conceptions of teaching and learning mathematics are compared with 'views' of the literature. In the second instance, a classification was developed concerning the knowledge base of mathematics. The three dimensions that were identified were concerned with conceptual links, with process integration (into teaching) and with completeness of pupils' mathematical experiences. In the third instance it is claimed that traces of those dimensions and ideologies of mathematics education can be traced in the textbooks used, which in turn helped to develop an understanding of teachers' practices. Textbooks reinforced those particular positions on those three dimensions. The researcher argues that the ways mathematics was explained and presented in textbooks helped to understand teachers' practices in the classroom.

Philosophies of mathematics and mathematics education underpin teachers' practices

According to Ernest's conceptions of mathematics (1988) there are three philosophies, and in another of Ernest's work (1991) five ideologies of mathematics education are suggested, which he proposes as tentative categories for groups of teachers working in the British context. However, he asserts that the ideologies need not be bounded by nationality. It was found in the comparative research (Pepin 1997) that all French, German and English teachers studied, consciously or subconsciously, ascribed to one or several of three of Ernest's theories: the 'technological pragmatist'; the 'old humanist'; and the 'progressive educator'.

However, although all teachers appeared to subscribe to one or several of the three categories, there were different weightings and emphases in the different national systems. In England the emphasis in the classroom was on the utilitarian and pragmatic side ('technological pragmatist' view) combined with the individualistic and child-centred view. However, teacher educators in England espoused the 'progressive educator' or 'public educator' (Ernest 1991) philosophy, and there were traces of what would be described as 'humanist' traditions in what teachers said, but neither tradition was recognisable in English teachers' classroom practices. In France teachers traditionally regarded mathematics teaching as important for 'training the mind' ('old humanist') and for work preparation ('technological pragmatist'), whereas more recently theories of mathematics teaching were encouraged where personal exploration was to be facilitated ('progressive educator'). Therefore, French teachers showed a mixture of three philosophies. In Germany it depended on the school type which ideology was adopted. Whereas in the *Gymnasium* the 'classic' view of mathematics as a body of structured knowledge prevailed ('old humanist'), the *Hauptschule* adopted a more pragmatic view where 'useful knowledge' was to be transmitted ('technological pragmatist' view).

Ernest's attempts to classify philosophies looked helpful, and it was interesting to note where teachers appeared to be on this classification. However, although Ernest's classification was useful to a certain extent, it was not entirely appropriate in order to develop an understanding of the twelve

teachers in the three countries. There were additional dimensions and it was therefore decided to develop a new way of looking at the issue of teachers' beliefs and conceptions in relation to their practices and in terms of the rich data that were available.

Three 'original' dimensions that underpin teachers' practices

The first classification that was developed was concerned with the coherence of the mathematics taught, which was concerned with conceptual links, the 'inter-connectedness' of concepts, and with ideas of a body of mathematical knowledge or a set of beliefs about the coherence of mathematical concepts. There seemed to have been a range of interpretations, from the emphasis of the conceptual link between the (mathematical) knowledge base to no emphasis of the conceptual link, and teachers could be put somewhere within that range. For example, in France teachers expected from themselves (and were expected by the inspector) to have a certain distance from the content they were teaching, in order to be able to see its links to other areas of mathematics and subsequently be able to identify effective ways of teaching the content.

Secondly, a process dimension about teachers teaching mathematics was identified, in which it was either neglected (as in Germany) or was seen as integral to the learning of the mathematics (as in France). The whole idea about logical thinking was generally also part of that dimension. For example, in France teachers emphasised the process element by preparing cognitive activities for pupils. The idea of 'letting pupils discover' was linked to the teaching of the content, and therefore combining process and content. In England investigations appeared to be done separately, as a separate issue which seemed to be almost like another area of content.

Thirdly, there was the dimension concerning the coherence of pupils' mathematical experiences. For example, in Germany and in France pupils were expected to reach certain levels at the end of every school year, otherwise they had to repeat the year. On the other hand, in England pupils reached levels of the National Curriculum and some progressed further than others within the same year. This led to a particularity which was not evident in France and Germany, in the sense that English pupils could leave school after year 11 whichever level they had reached.

Other examples for the three dimensions were given by French teachers. The reasoning and training-of-the-mind aspect of mathematics was repeatedly emphasised by French teachers (and the inspector) and the researcher could see this conviction in practice in the classroom. Pupils had to reason (sometimes with rigorous proof) their results and they were given cognitive activities (problem-solving) to discover notions of mathematics for themselves. The emphasis was on the process and not the result. French teachers were genuinely concerned about the essence of the lesson and how to teach it best, what would enhance pupil understanding, and that all pupils were able and entitled to learn the whole of mathematics (taught at that age level). French teachers focused on developing mathematical thinking. They tried to pose thought-provoking problems and expected students to struggle with them. They drew together ideas from the class and the whole class discussed solutions. Teachers tried to forge links between ideas, skills and 'cognitive activities'(small investigations) on the one hand, and concepts on the other. Therefore, it is firstly argued that French teachers' perception of different facets of mathematics (inter-connectedness of concepts, process-orientated, entitlement) resulted in a picture of mathematics as a whole. It is secondly argued that teachers' perceptions of how mathematics was structured, its unifying concepts and methods, in other words its 'wholeness', influenced their teaching in such a way that various cognitive approaches were used to provide a learning-enriched environment. Thirdly, by expecting the whole class to move forward together, French teachers' practice reflected egalitarian views, and their emphasis on mathematical reasoning reflected the cultural tradition of rationality, one of the encyclopaedic principles (embodied in the notion of *formation d'esprit* – training of the mind).

In Germany, the view of mathematics which teachers revealed was relatively formal and included logic and proof ('old humanist' view). It included a view of the teacher's role as that of the explainer who taught the structure of mathematics through an 'exciting' delivery and by adapting the structured textbook approach meaningfully. German teachers' views of mathematics also included teachers' aspiration to treat each topic in relative depth (notion of quality) which in turn meant that they spent considerable time on each topic. This view of mathematics went hand in hand with their view of teaching, in the sense that they used traditional (in Germany) front-teaching approaches (*Frontalunterricht*) combined with the conversational interactive style. The conversational style allowed them to discuss topics in relative depth and to monitor pupils' misunderstandings by involving the whole class in discussions. In terms of the three dimensions, the dimension of conceptual links was reported by teachers in discussions. Although it was not made explicit in their classroom practices, through spending extended time on each topic (i.e. less fragmentation) there seemed to be conceptual links. The process-orientation was not detectable. Teachers tried to transmit their knowledge to pupils as effectively as possible. The third dimension, at which point pupils were allowed 'to jump off', depended on the school forms. In general pupils were expected to be taught and to learn the curriculum of the particular year and of the particular school type.

In England, the emphasis was on the skill side of mathematics and results. The notion of 'training-the-mind' for logic reasoning was missing, except for the high ability sets and some investigative tasks. This, combined with teachers' determination to keep pupils busy and entertained, led to an impoverished mathematical diet for some low achieving children. Although teachers talked about logic and proof as their aims, their teaching generally did not include these aspects. They were concerned with covering the content of the curriculum. English teachers spent relatively little time explaining concepts to the entire class, and they introduced and explained a concept or skill to pupils, gave examples on the board, and then expected pupils to practise on their own while they attended to individual pupils. Situations where pupils discovered multiple solutions or investigated new solutions that required reasoning were rare and usually reserved for 'investigation' lessons. Therefore, firstly it can be claimed that notions of justification and proof (to be taught according to Attainment Target 1, level 7 and 8) were only taught to the high achieving children in their respective sets, and with the lower achieving set children being deprived of this experience. Secondly, investigations and content were taught at different times, resulting in the separation of process and content. Thirdly, process-orientated teaching through investigations and problem-solving became an activity in its own right, where teachers tried to teach pupils to 'behave mathematically' rather than ask them to think about the structures their patterns might illuminate. Although the texts (National Curriculum non-statutory guidelines, or the Cockcroft Report, for example) emphasised the connection of process and content, most English teachers did not practise according to the texts. They regarded it 'difficult' to teach 'investigatively'. It appeared that either lessons focused on process elements (i.e. 'doing' investigations for course work) or on content elements (as in teaching AT2, AT3 and AT4 of the National Curriculum), but with no links between the two. In addition, English children were presented with different topics at close intervals. Notions, such as percentages, for example, were taught for a relatively short period of time, and expected to be revisited at a later stage. It was assumed that, if pupils revisited a topic often enough, they would finally understand. This also led to relatively erratic jumps from one topic to another and the notion of the 'spiral curriculum' supported this idea.

In terms of inter-connectedness of concepts, this gave the impression of a fragmented view of mathematics (which the teachers surely did not have) and there was a coherence missing. Concerning the completeness of experiences, it was accepted that some pupils (because of their low achievement) would have access to only part of the curriculum. Pupils were generally grouped in achievement sets and lower achievement set pupils worked through the National Curriculum at a slower pace

than the higher achievement sets – all strategies that derive from an individualistic approach (as part of the humanistic philosophy). This, in turn, meant that each pupil's mathematical experience was determined by the level they reached in the National Curriculum, whether or not this led to a coherence of mathematical experience or not.

Mathematics textbooks reinforce particular positions on those three dimensions

In all three countries textbooks were mediated, to a greater or lesser extent, by teachers. It is argued here that the ways mathematics was explained and presented in textbooks helped to understand teachers' practices and that they were in line with the practices that were observed in the classroom. It was not clear the extent to which textbooks could either challenge or modify existing practices in a country, but certainly in England, where most teachers followed textbooks and reported little time for preparation, one could speculate that their potential was not fully exploited by curriculum developers.

In Germany (especially in the *Gymnasium*) there was one textbook for algebra and one for geometry, each covering two years. Interestingly, algebra and geometry were taught quite separately. This indicated that there was hardly any inter-connectedness between the two domains. For every chapter in the books there was a short introduction to the notion for each topic, followed by routine exercises leading to relatively demanding problems. Topics were explained in depth (although with relatively short and formal explanations) and there was relatively little 'revisiting' of topics. Textbooks emphasised the mathematical content in its structured and pure form, with a hierarchical structure connecting the topics. This reinforced teachers' views that knowledge was to be taught in a structured way. The mathematics was given to teachers and they knew that they were to convey the content to pupils. The textbooks neither suggested nor encouraged particular teaching approaches and therefore did not attempt to provide pedagogic stimulus and guidance to teachers.

In France, textbooks were chosen by teachers and schools. Those books integrated specific (cognitive) activities in order to encourage teachers to teach in the ways encouraged by the inspectors. The books provided teachers with support for the preparation of their lessons, in terms of introductory activities as well as in the selection of appropriate exercises. Teachers in France were encouraged by their inspectors to prepare their lessons carefully (to step back and think about the 'best' way of teaching a topic), and approved textbooks suggested how to introduce topics with cognitive activities.

In England, as many as six textbooks covered the content for two years, and topics were often revisited from one year to the next. Textbooks were usually presented with brief explanations, cartoons and pictures in the introduction followed by exercises. In theory, teachers were expected to follow the departments' schemes of work, and these comprised a list of topics to be taught to the year group and set, with reference to chapters in various textbooks. In practice, teachers 'ran through' those suggested topics which reinforced the notion that each part of the mathematics programme was separate, unless the departmental schemes of work provided for the inter-connectedness of topics. Activities were not integrated in the sense that teachers taught a chapter and then did an investigation which might or might not have a connection with the chapter that had been taught. Topics were revisited in the textbooks, in line with the notion of the spiral curriculum where it is assumed that children gain a deeper understanding of a topic if they were introduced to the notions on several occasions. It was difficult to find a textbook in England which promoted the kind of cognitive activities that might help teachers to teach their lessons 'investigatively' (investigations are given at the end of chapters, as side-aspects of the main content teaching).

Conclusions

The findings of the research demonstrate that teachers' classroom practices in the three countries reflected their beliefs and conception of mathematics and its teaching and learning. Teachers' beliefs and conceptions could be traced back to philosophical traditions of the three countries, and to epistemological and educational trends of mathematics and mathematics education. Looking at the literature there is a powerful argument that systems are the main determinant for different pedagogies practised in different countries. In this paper it is argued that there are subtle and 'non-visible' forces at work in classrooms of our schools. They are the often unvoiced principles, philosophies and beliefs that penetrate the educational setting. It is suggested that teachers' pedagogical styles are a personal response to a set of institutional and societal constraints (e.g. curricular organisation), to a set of educational and philosophical traditions, and a set of assumptions about the subject and its teaching and learning. Thus, it is argued that teachers' pedagogies need to be analysed and understood in terms of a larger cultural context and in relation to teachers' conceptions and beliefs, and that a lack of such understanding is likely to inhibit the process of change at all levels of the system.

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Mathematik Didaktik (Teaching-Learning Mathematics): *an overview of the development of a Web-based European Module*

Abstract

This paper outlines the development of the chapter (module) Mathematik Didaktik as a part of the electronic 'text book' Didaktik/Fachdidaktik developed by TNTEE Subnetwork E. The overall approach to the development of the module is based on a model of teaching-learning as an 'integrative transformative science' that pays due attention to the general aims of society as well as curricula, content and learning situations. As part of this perspective, teacher competence is broadly conceptualized in terms of "professional action structures" in contrast with the narrow emphasis on technical competence and on mechanistic conceptions of a 'technology of teaching' that currently prevail in some parts of Europe. The teaching-learning approach is based on problem-oriented, research-oriented and co-operative learning processes. Underpinning the development are particular ideas about the nature of mathematics itself. In particular the starting point for the development is around 'big ideas' in mathematics – in contrast to the fragmentation that is evident in the thinking of some policy makers at this time.

Rationale

The overall approach to the development of the module is based on the model of teaching-learning as an 'integrative transformative science' (Buchberger and Buchberger, 1999) that pays due attention to the 'general aims of society' as well as to curricula, content and learning situations. As part of this perspective, (beginning) teacher competence is broadly conceptualized in terms of "professional action structures" in contrast to the narrow emphasis on technical competence and on mechanistic conceptions of a 'technology of teaching' that currently prevails in some parts of Europe (Reynolds 1998). Such structures involve subject-related and "didactic" competence, methodological (teaching-learning) competence, management of learning groups, diagnostic competence, counselling competence, metacognitive competence, new media competence and co-operation. Accordingly the teaching-learning approach in Initial Teacher Education (ITE) is based on problem-oriented, research-oriented and co-operative learning processes.

The title of our chapter expresses implicitly at least two beliefs about mathematics education: firstly that there are three crucial elements involved, the mathematics, the teaching and the learning; or alternatively, the content, the teacher, and the learner. However these three elements only make

sense in a mutual triad where no aspect is given primacy. Pedagogies, though, tend to stress one aspect at the expense of others, for instance claiming that the most crucial question is "How to teach?", "How to learn?", or "What is mathematics?". A central aim of this module is to develop a theoretical-practical platform for bridging the gap of this pedagogical triad. Secondly: practical schooling in mathematics has normally focused on the 'what' i.e. what the teacher teaches or what the learner learns or what the textbook describes. At the same time *language* and *communication* have tended to be treated as additional aspect to mathematics. By seeing teaching-learning fundamentally *as* communication, it becomes clear that an approach that is one-sidedly preoccupied with mathematics as spoken or written content, is accordingly 'text-oriented'. Text is here taken in a broad sense. Unfortunately this 'what-oriented' perspective often brings with it a lack of understanding of the *non-text*, or the *context.* In communication there will always be an intimate interplay between what is said and what is not said, and the unsaid rests in the context. Hence, by focusing on teaching-learning *situations* in mathematics, we hope to problematize how mathematics education is contextualized or needs to be *recontextualized*. However, context is a notoriously difficult concept to grasp, theoretically and practically in its full sense, since logically and practically always there will be a context outside the context outside the context etc.

In the development of this module we will draw on some 'didaktik models' that are in use. The idea is not to give a scenario of representative models, but rather to rethink, on the basis of a communicational framework, what educational point of departure or *perspective* actually implies. The four co-authors of this paper have, for instance, different educational backgrounds, professional attitudes and practical experiences, which have forced upon us the question of whose preferences are most valid and relevant. We do not have a fixed answer, neither in this module nor in general, but we hope to enable student teachers of mathematics to rethink some principles, and consider what *they* think is most important, to clarify *their* own implicit perspectives, *their* 'didaktik' point of departure, without ending in pure *perspectivism*.

Also we need to reflect on the nature of mathematics itself and in particular to consider what might be the 'Big Ideas' (Faux 1998) in mathematics – in contrast to the fragmentation that is so evident in the Anglo-American tradition (Hudson 1999a and Pepin 1999). The concern about the atomization of subject matter based on the American tradition of 'instruction' was highlighted by Freudenthal (1978: 97) though at that time he held up the British 'integrating interpretation of educational innovation' as a model of good practice and saw pedagogues and general didacticians as part of the problem:

Indeed, atomization of subject matter is not merely a behaviouristic concern. It is the line of least resistance in technologising instruction. Pedagogues and general didacticians judge mathematics to be their most appropriate victim. Indeed in mathematics you can isolate and enumerate all concepts in order to have them trained systematically one by one, in pairs, in triples, as far as you want to go. It is a caricature of mathematics which is quite common. Therefore no subject is exposed to ruin by atomization as mathematics. It is too obvious that by atomistic instruction you cannot teach creativity in speaking and writing … But mathematics seems to invite atomization, and so mathematics is hard to defend. Isolating, enumerating, exactly describing concepts and relations, growing them like cultures in vitro, and inoculating them by teaching – it is water to the mill of all people indoctrinated by atomism.

Such a view of mathematics is one that Fruedenthal (1978: 96) considers 'every mathematician will detest from the depths of his/her heart'. However mathematicians and mathematics educationalists have been unable to resist the technologising force of the bureaucrats and politicians on the national curriculum of schools in England and Wales, which has also more recently been applied to teacher

education itself. These issues highlight the need also to consider epistemologies of mathematics and mathematics education as a component of a module on the teaching-learning of mathematics. A full discussion of the ways in which epistemologies and educational traditions 'permeate through to teachers' pedagogies in schools' can be found in Pepin (1999).

Teaching-Learning Mathematics

Mathematics education as methodologism

Preparation for performance has often been developed into a separate art form in important fields of skills and knowledge as a general method and almost as a field in itself. For example *rhetoric* was developed over centuries and across cultures to handle different communicational situations. However, in more recent times, this *metier* faded out, although some of its traditions were (tacitly) carried on into European school systems. Thus the main idea, or perspective, was retained, i.e. content can be handled by more or less general *methods.* This implicit standpoint gave the practical and theoretical premise for a *general didaktik.* From this perspective *content* was seen as relatively unproblematic.

As recently as the 1960s teacher education in most European countries had a *methodological* orientation. Hence to *teach* mathematics was considered as a practical activity. One started from the textbook, in which referred knowledge was seen as more or less given, and which was to be kept in line with prescriptions in the written curricula of the national state. Student teachers were stimulated by teachers in *pedagogy* to think about which pedagogical principle(s) might be relevant to use in preparing lessons in the school disciplines: Was it Kerschensteiner's work-school principle, or Dewey's learning by doing, or Maslow's hierarchy of basic needs? In Norway student teachers had to record beforehand *what* they would teach and an *aim* or a *purpose* for each lesson. This tradition was accordingly partly indebted to Tyler's rationale, but perhaps without understanding the differences in *context* between the two cultures in question, the US and Norway (Strand and Kvernbekk 1998).

Critical alternatives to the methodological tradition

In many European countries teacher education in the 1960s consisted of pedagogy, disciplines and praxis, with 'methods' added more or less as a topic to one of these elements. However many teachers in pedagogy were critical of what went on in practice, and wanted a more holistic approach. *Didaktik* and not *metodik* was the discipline which should create more reflexive understanding and wholeness.

In the early 1970s a progressive movement within the disciplines in schools led to the development of a new discipline in many teacher education colleges in Europe – that of *Fagdidaktik*. This was intended to extend the practice of a limited *Fagmetodik* to a mutual combination of the discipline and its *didaktik*. This new 'discipline' was soon captured by the terms *what, how* and *why*. These terms were not intended to be understood as three separate elements. The conscious and conscientious student teacher, the democratic written curriculum and the progressive textbooks were intended to treat this as a set, as three dynamic *relationships*, the *what-how*, the *what-why*, and the *how-why*. This was the general intention. However the different disciplines adopted this new perspective in quite different ways.

For example in books on mathematics *didaktik* in the 1980s this understanding received somewhat different interpretations. For example, Solvang's (1986) *Matematikkdidaktikk*, a much used Norwegian book in teacher education for upper secondary education, includes a chapter called *Main elements in math teaching and learning*, which is concerned with the planning of teaching and the delimitation of *didaktik*:

In chapter 2 we dealt with bits of the field which traditionally has been called the didaktik aspect of the discipline. There we looked at problems concerning the selection of [subject] matter, organization of [subject] matter and the goal for our math teaching. In addition to this one has mentioned the methodological aspect of math teaching, often called math methodology or math [fagmetodikk]. (...) If we look at those/these two aspects of teaching math as a school discipline based on research over the last 20 years, it will be difficult to keep them separate as suggested above. This has lead to the use of math didaktik among writers as a collective concept. The intention with the matter we will discuss in this section, is to enable the teacher to make systematic reflections on how she can:

– prepare teaching
– carry out teaching
– analyse the accomplished teaching with possible improvement in mind

(...) When the disciplinary and the general goals are made ready, we can start the framing of the actual plan:

– WHAT is going to be done
– THE PURPOSE in doing this
– HOW to carry out this
– WHY carry out this in such a way

In addition to these four points the planning will include choice of means and control of to which extent the disciplinary goals are achieved/reached. (Solvang 1986: 41–44)

Solvang's claims that mathematics didaktik could be seen as a compound of general didaktik and mathematical methodology, is not in line with what happened in Mother Tongue Education (MTE), which took a more independent direction by developing the new *fagdidaktik* more directly from the discipline (Ongstad 1999). Hence the *why* has had a stronger position in MTE. Solvang, being closer to general didaktization and methodologism, accordingly operates with a special variant of the what-how-why triad. The why is weakened and reduced to a question of defending the selection of methods. The more basic reason for this may be that mathematics as a subject may be seen as relatively unproblematic. The why is cut off from having a critical function. Hence the why has not grown from the discipline as such, but from the heritage of methodologism within the discipline. We should underline that there is nothing morally or professionally wrong with such a perspective, and that Solvang has elsewhere touched upon the more critical aspects.

In Uljens (1997) the logic relationship between general pedagogy, general didaktik and fagdidaktik is inclusion:

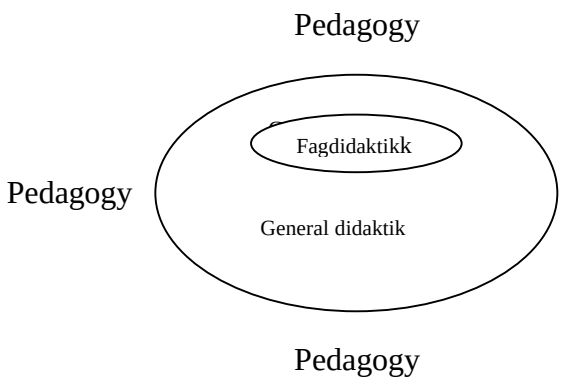

Figure 1 Relationship between general pedagogy, general didaktik and fagdidaktik (Uljens, 1997)

According to Gjone (1998) this is the preferred *perspective* in pedagogy. He presents this understanding with respect, but adds:

However fagdidaktikk connected to central school disciplines had an independent development, so that even if one uses general pedagogical methods (methods from educational science), there exist for many fagdidaktizians a distance to general didaktik and pedagogy. Since the end of the 1950s there has grown up a strong international consciousness about mathematics didaktik as a separate discipline or research field. Based on a fagdidakik perspective the following diagram would be more relevant for a 'positioning' in relation to other fields:

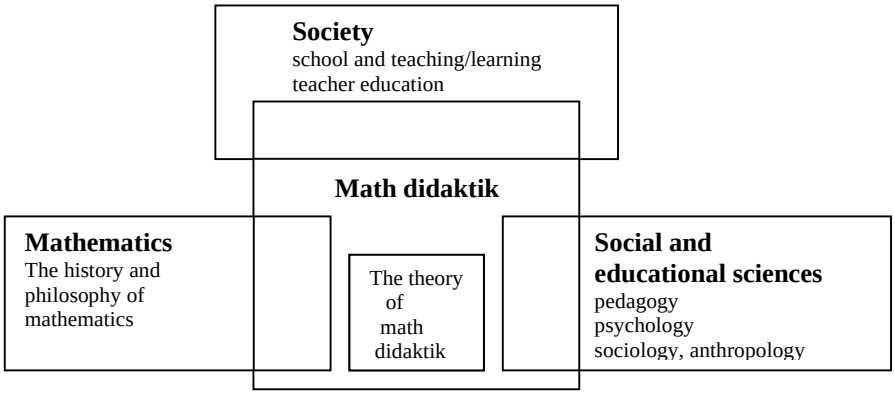

Figure 2 'Positioning' of mathematics didaktik in relation to other fields (From Gjone 1998: 84)

Hence mathematics didaktik for Gjone includes aspects of such central elements as a theory of science, pedagogy/didaktik, psychology (learning), discipline (mathematics), methods (practical), language (communicational) and critique (social). (Gjone 1998: 85–89) However he points also to other approaches such as Biehler *et al.* (1994).
Further, even scholars within general pedagogy were critical about the lack of broad and systemic understanding of didaktik. At the end of the 1970s and beginning of the 1980s many new models were coined to try to grasp the new complexity for didaktik as a whole.

The Didactic Relation Model or Relational Curriculum Design
The discussion in this section is based on Bjørndal and Lieberg (1978), Imsen (1997) and Strand and Kvernbekk (1998).

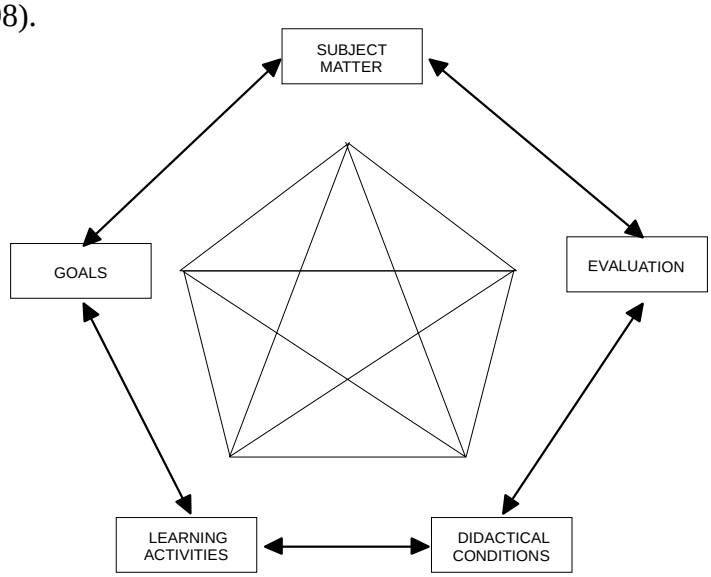

Figure 3 Relational Curriculum Design (Bjørndal and Lieberg 1978, Strand and Kvernbekk 1998)

The model in Figure 3 represents a much used Nordic approach and is termed "relational curriculum design" (didaktisk relasjonstenkning). It is meant to help student teachers and practising teachers to plan, process and evaluate teaching (Bjørndal and Lieberg 1978: 132–133). The model emphasizes the internal relationship between variables such as didactical conditions, subject matter, goals/ aims, learning activities and forms of evaluation. Deliberately no starting points or directions between the factors are given. Thus considerations may start from any point. According to Bjørndal and Lieberg (1978: 44) the intention in a broader sense is to create points of departure for processes of teaching and upbringing.

The model is closely linked to an educational system in which the national curriculum states the goals for education and describes subject matter, themes and to some degree teaching methods. The national curriculum is therefore supposed to represent the start for every teacher's curriculum design, but cannot itself function as a direct guide to teaching. Hence the supposed need for a model. (For a specific critique of the use of models in the field of didaktik, see Strand and Kvernbekk 1998.)

There are different ways of criticizing a model that claims to be complete (Imsen 1997: 336). One is fundamental and illustrates a deep scepticism of the very use of models. Another is to attack the precision of the concepts. Finally the model's ability to grasp relevant aspects may be questioned, which pinpoints the criticism to a question of purpose. This particular model has been criticized for not being able to highlight hidden structures (Imsen 1997: 37) in schools and classrooms ("the hidden curriculum") and for underestimating the importance of organizational aspects in general. (Imsen 1997: 336)

From the perspective of mathematics it could be asked whether the model is specific enough to catch the very nature of mathematical education. As far as we know no Norwegian book that might be termed 'mathematics didaktik', refers to this model. Solvang (1986), Breteig and Venheim (1998), Nygaard *et al.* (1998), Tufteland (ed. 1998) and Herbjørnsen (1998) covering different educational levels, do not mention this model. Thus most student teachers of mathematics education in Norway during the last decade will have met, or will meet, at least two different, non-related kinds of curricular thinking. One tries to develop general, relational thinking, based on pedagogy, whilst the other focuses on the different specific elements that make the teaching and learning of mathematics significantly different from other disciplines. The intention of this module on Mathematik Didaktik is to help to bridge the gap resulting from this divide, which is a general educational problem in Europe.

Teaching-learning as communication

Unenge and Wyndhamn (1986: 107) claim that teaching-learning simplistically can be described as a triangular drama between student, teacher and (subject) matter. The sides in such a triangle will signify the communication***s*** (in plural) that will take place.

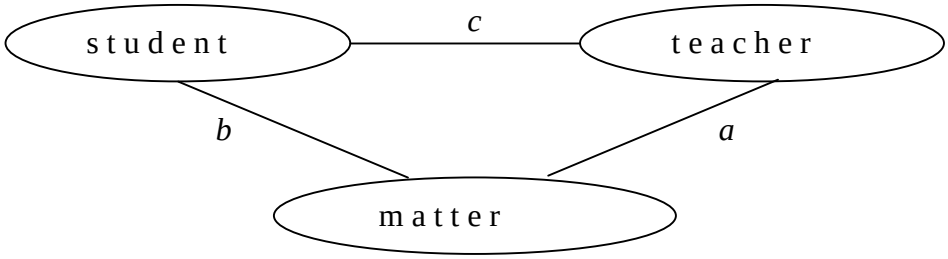

Figure 4 Triangular drama between student, teacher and (subject) matter (Unenge and Wyndhamn, 1986: 107)

Side *a* is the teacher's knowledge about the (subject) matter, his or her didactic theory. Side *b* is the student's communication with the matter, what s/he is going to learn. Side *c* represents the communication between the teacher and the student. The result of this drama is supposed to be that the student actually learns. However, according to Unenge and Wyndhamn, rows of research results show that this does not happen as simply as the figure might suggest. They claim that side b does not exist, since the student has a *pre-configuration* of the 'matter'. Instead they present an extended model with five corners where *experiences* play an important role (Unenge and Wyndhamn 1986: 108).

However Unenge and Wyndhamn have *not* really addressed the question of communication in spite of the fact that it is their explicit point of departure. The (subject) matters do not appear for us as 'matter' they arrive as 'utterances': from mathematicians in the past, from textbook writers, from educational agents such as the government, school authorities or teachers. Further an utterance arrives in a *context*, formed by *discourses* and/or *genres* of the discipline, school and everyday life. And how we understand these utterances depends on which communicational *aspect* we tend to perceive as important or *dominant*. Let us look at the student–matter line. If this matter is a mathematics problem, the basic process in the student's head is *thinking*. Accordingly we see matter as *content. Logic* thus becomes important. In our research we seek for a sensible didaktik to find support for a *cognitive* preference. The work of Piaget and the field of cognitive psychology will be seen as highly relevant.

However the utterance can also be seen as an *act*. Someone tries to 'force' you as a student to *do* something. The following kind of utterance, in the *context* of school and mathematics invites, forces, teases, you to *answer*, or in other words, to *perform*. It is seen as a communicational genre known and recognized as a *task*: e.g. find x when $3x = 45$. Of course one needs thinking, knowledge and logic to *solve* the 'problem', but seen from the *perspective* of action, the utterance asks social questions such as why is this mathematics? Do I have to do it? Why should I do it? Whose parents have given their children a good start and motivation for this kind of 'pursuit'? What do you need to make sense out of a sport like that? These 'impertinent' or critical questions may lead us in different directions. Utterances and accordingly mathematics can be seen as *activity* (Leontjev 1978 and Davydov and Markova, 1982–83). Alternatively mathematics and mathematical utterances can be seen as socially dependent on *culture*. Hence Vygotskyian (1962) approaches seem valid and relevant, focusing on the social or cultural (Bishop, 1991) conditions for the development of thinking. Further, mathematics can be related to questions of power and politics (Mellin-Olsen, 1987).

Utterances have a further *third* dimension in addition to content and function/action. Its most immediate and direct aspect is its appearance, its *form*, depending on the medium or the channel through which it is brought to us. However this third dimension is often the forgotten dimension. Mathematics is not only logic and culture but also it has a profound aesthetic aspect, recognised by many. Mathematics is hated and loved, it is awful and beautiful, it is clear and unclear, negatively frustrating and positively challenging.

Thus an utterance or a sign or a word or a text or a text element is triadic. Metaphorically, three traditional word classes can help to illustrate the nature of the main aspects involved: a noun for cognitive content and reference, a verb for social process and action and an adjective for emotional reactions to form and structure. Or, to put it differently, the noun helps us to categorize, to see the focused phenomenon as a delineated thing, as an object in the 'real' world that can be conceptualized in the mind. Categorization, nominalization and conceptualization help us to keep what we learn stable for a moment, but at the same time we easily lose sight of the process, the social relation the phenomena are part of, not to mention the emotional qualities of the 'thing' in the learner's mind/body.

The mixture of these basic elements goes on mutually and continuously. The challenge for teaching-learning is that we cannot know what is most relevant. We have to know the situations, the context. A general understanding of logic, or insights into children's social background, does not help the teacher much if the child in question hates mathematics. Even mathematik-didaktik has to relate explicitly to such traditional triads as *feelings, thought, will*, or *beauty, truth, goodness*, or *experience, understanding, action*. They can all be put into a triadic understanding of didaktik, which has an explicit communicative foundation. This didaktik will have three main inseparable (= reciprocal) aspects:

Figure 5 Triadic understandings of didaktik

Aesthetics	Epistemology	Ethics
student	matter	teacher
teacher	matter	student
form	content	use
structure	reference	action
feelings	thought	will
beauty	truth	goodness
adjective	noun	verb
heart	head	hand

The most important source for the first (left) column is the *inner nature* of the utterer/receiver (*self* in the broadest sense) (Habermas 1981, 1988). Therefore expertise perspectives in this corner tend to be dominated by *psychology*. Similarly, the most important source for the middle column is *outer nature* (*world* in the broadest sense), and here disciplines which help us to explore 'matters' will be relevant. Finally the third column's most important source is our relationship to *others* (or *society* in the broadest sense), understood, however, not as a social place, but as dynamic processes and relations embodied in people who reproduce it and change it only when acting, by uttering (Giddens 1984 and Dewey 1916).

We touched on the question of *context* above. Generally this concept has been taken too literally despite the warnings from theorists in sociology and psychology (Bourdieu 1977, Bateson 1972). If we start from a teaching situation in mathematics, this 'situation' will be heavily influenced by the *genres* by which the utterances are framed. Let us say there is a mathematical genre that is taught, for instance triangles. It is taught in a certain classroom genre we all know – a mixture of blackboard presentation and individual calculation, combined with the teacher circulating in the classroom, helping students. Contexts then are mixtures of more or less specified and conscious genres.

These genres, which are resources for ways of communicating, may *add* elements to each other. Thus a 'class' is a lesson where a bell is ringing, then the teacher starts explaining graphs, then students ask or are being asked, then students work on tasks, then a bell is ringing, and then the class is over. Or genres are *intertwined* or form *families*, for instance as a mathematical progression in textbooks from basic presentation of the coordinate system, via parables, to a general advanced understanding of conic sections. Or they are *encapsulated*, like *Chinese boxes*: triangles, in trigonometry, in tasks, in exams, in schools. However this mixture of genres is not untidy for a person who is enculturated to this growing system of genres. It is precisely our capacity to move rapidly 'in' and 'out' of different genres that make us able to communicate in and with contexts. Solomon and O'Neill (1998) provide further discussion on the notion of mathematics as genres.
However there are different kind of genres. Some are shaped for description and reference, such as

definitions, photographs, patents etc. Alternatively, others are shaped for action and performance, like commands, instructions and tasks, or for seemingly aesthetic purposes, like paintings. However they all run the risk of being interpreted dysfunctionally. This is the reason why cognitivists tend to try to increase the refinement of their methods and approaches in explaining how students can or cannot learn mathematics. This is the reason why action researchers fail to change school. This is the reason why student oriented teachers keep a good relation to their students, but may fail to teach them mathematics. All this suggests that the interpretation of the context for mathematics teaching and learning is deeply rooted in a lack of communicational understanding. Triadic thinking of this kind will not necessarily help teachers to avoid misunderstanding. It is primarily a tool for becoming *aware* of what is *not* thought of in the moment of utterance and in the moment of interpreting. *Didaktik* is such a tool, and therefore a sound understanding of communication is basic for any teaching-learning situation.

Such a 'didaktik' point of departure is consistent with, but also adds to, that offered by the work of Gattegno (1987) who has been an influential figure on practice, if not policy, in mathematics education in England and Wales, principally through the profound influence of his thinking on the work of the Association of Teachers of Mathematics. In reflecting on his contribution Tahta (1988) comments that "Gattegno's proposal is that shared awareness is an appropriate basis for a science". He suggests the need to enlarge our notion of science and argues that all sciences begin with a new awareness – "of light, or sound, or, in the case of mathematics, of relations as such". He argues further that the science of education "is concerned with the awareness of awareness itself". An important role for the teacher according to Gattegno is in "forcing awareness". This has echoes of the role of the teacher in Vygotsky's (1962) Zone of Proximal Development (ZPD). Tahta also discusses "ways of knowing" and gives the example of "intuition" which is illustrated in relation to the use of geoboards, Cuisenaire rods and mathematical films. He argues that intuition "demands the whole of one's self" and that this is what is required when one meets and tries "to maintain complexity". He argues that it operates in "precisely the opposite way to the 'focusing' traditionally stressed in Western thought and education". A further parallel can be found in the work of Jaworski and her use of what is described as the 'Teaching Triad' (Jaworski and Potari, 1998) which is composed of three domains: Management of Learning, Sensitivity to Students and Mathematical Challenge. It is seen as a framework 'to capture the essential elements of the complexity involved'. All these aspects are seen to be consistent with a 'didaktik' point of departure.

The What and Why of mathematics

As indicated earlier, we also need to reflect on the nature of mathematics itself and in particular to consider what are the 'Big Ideas' in mathematics – in contrast to the fragmentation of the National Curriculum for England and Wales and also of the 'Standards' of the Teacher Training Agency (Hudson, 1999b). We need also to consider epistemologies of mathematics and mathematics education and the way in which these and educational traditions permeate through to teachers' pedagogies in schools. Further we need to ask the question "why mathematics?"

The article by Faux (1998: 12–18) is very relevant here; he draws on the thinking of Gattegno and Freudenthal in particular. He suggests the following list of 'Big Ideas' in mathematics:

- Numbers are ordered and well structured
- Mathematics is shot through with infinity
- A lot for a little
- Equivalence
- Inverse
- Transformation

He illustrates the idea of 'a lot for a little' with reference to working on a '100 square' i.e. a 10 by 10 square grid containing the numbers 1 to 100 in ordered rows of 10. Using the example of asking the question: 'What is the sum of the numbers 1 to 100?', he illustrates how he extends the activity by asking: 'What can we now do because we have solved that problem?' and: 'what is now available to us? The sum of the first 20 numbers: is that directly available?' He uses this example to show how he can 'gain a lot for a little' and proceeds to elaborate on his own philosophy of mathematics:

For me it's an important idea. It was what attracted me to mathematics when I was in school. A lot of subjects were dense with things that I first had to learn in disconnected ways – French words, history dates. In mathematics I could get started with very little and get on and get success; there were no disconnected facts to learn. That was important for me.

These words will speak powerfully to those with an appreciation of the nature of mathematics and will no doubt fall on barren ground for the 'atomisers' and 'technologisers'. However these principles will inform the development of the module Mathematik Didaktik.

Others aspects (not exhaustive) which have been identified for development include:

- Mathematics as logic, language and semiotics
- Mathematics in contexts
- History of mathematics
- Critical mathematics
- Realistic mathematics

Evaluating the Teaching-Learning of Mathematics

Research underlines the provisionality of knowledge. Teaching, at every level, is vulnerable if it does not acknowledge that error is a realistic intellectual achievement and failure a practical achievement, for a critical appreciation of error and failure is a necessary foundation for improvement. Research which disciplines curiosity and calls certainty into question, is a proper basis for teaching. (Rudduck, and Hopkins 1985*)*

Stenhouse (in Rudduck, and Hopkins 1985), in reflecting the crucial role of the university in teacher education, argues that the knowledge taught in universities is won through research and that such knowledge cannot be taught correctly except through some form of research-based teaching. 'Knowledge' that is represented as authoritative, and established independently of scholarly warrant, he argues "cannot be knowledge. It is faith". He argues further that what is unquestionable is unverifiable and unfalsifiable. In contrast our knowledge is questionable, verifiable and differentially secure. He highlights the point that unless our students understand that what they take from their experience is in error**:** the error that research yields established authoritative knowledge that cannot be questioned. Speaking at his inaugural lecture in 1979, his words seem prophetic: "That this error is widespread must be apparent to anyone who has listened to the questions asked of academics by laymen on television. And if we educate teachers who will transmit this error to their pupils, the error will continue to be widespread. We shall support by our teaching the idea that faith in authority is an acceptable substitute for grasp of the grounds of knowledge, even perhaps a substitute for faith in God … Once the Lord spoke to man: now scientists tell us that".

Research is seen as a strategy that is applicable not only to the humanistic and scientific, but also to the professional, disciplines. So that just as research in history or literature or chemistry can provide stepping stones for teaching about those subjects, so educational research can provide stepping

stones for teaching and learning about teaching. Such an approach, in contrast to the constituent disciplines approach, treats education itself – teaching, learning, running schools and educational systems – as the subject of research.

Problems are selected because of their importance as educational problems – for their significance in the context of professional practice. Research and development guided by such problems will contribute to the understanding of educational action. Therefore this provides the rationale for educational action research with the aim of developing thoughtful reflection in order to strengthen the professional judgement of teachers. Imsen's (1999) model for the interpretation of class activities and the learning circle is consistent with such an approach. It also reflects the position of the teaching-learning process in the wider societal context:

- Classroom level
- School level (organization, leadership)
- Local environment (home, local culture, municipal conditions etc.)
- Central level (state, national authorities)

In turn, this approach is resonant with that of Gattegno. As Tahta (1988) observes "the science of education uses aspects of watchfulness as its tools and a process of continuous feedback as its verification". These ideas are developed further by Mason (1994) through what he refers to as 'the discipline of noticing'. This approach works on ideas of developing awareness 'in the moment' – and has been developed in the specific context of mathematics education.

This rationale will underpin the development of that section of the module relating to the evaluation of teaching-learning situations.

Structure and components of the module

As indicated earlier, a central aim of this module is to develop a theoretical-practical platform for bridging the gap of the pedagogical triad: the mathematics, the teaching and the learning, or alternatively, the content, the teacher, and the learner. This paper outlines some of the major aspects of theoretical underpinning this development. However this project is 'work in progress' and the practical side of the theoretical-practical platform is the second stage in this process. In terms of the stage of development of our current thinking, Figure 6 encapsulates an overview of the structure and contents of the module.
At the heart of the module is the overall focus of this module, which is that of:

- Preparing, realizing and evaluating the teaching-learning of mathematics

In turn this can be seen to be at the heart of a web of interconnecting components:

- Teaching-learning situations
- Theories and practices of teaching-learning
- The what and why of mathematics
- Preparing teaching-learning situations
- Evaluating teaching-learning situations
- Readings and other resources
- Aims, goals and use of the module

The structure and components of the module have been designed with regard to the overall approach to the module which, as indicated earlier, is based on problem-oriented, research-oriented and co-

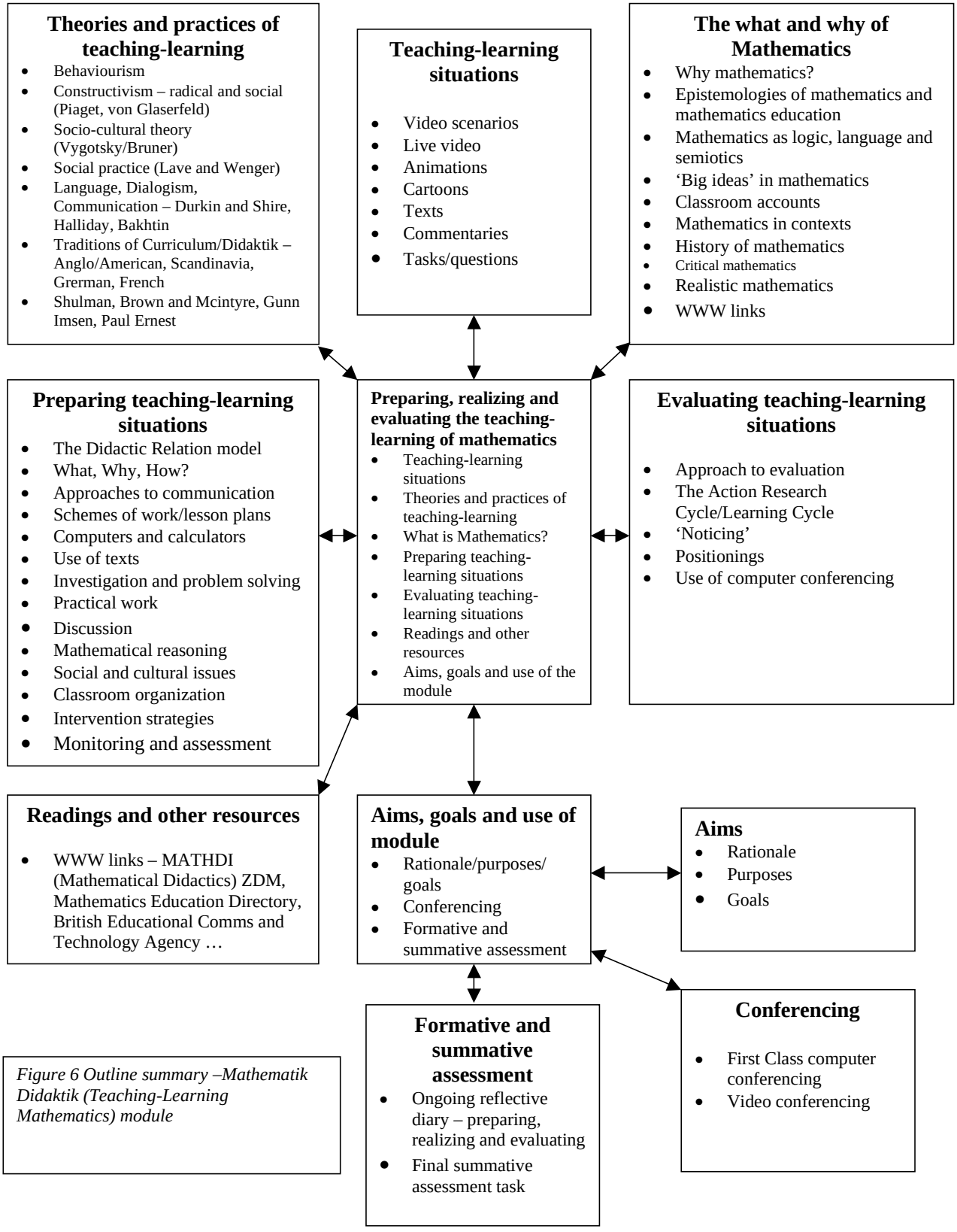

Figure 6 Outline summary –Mathematik Didaktik (Teaching-Learning Mathematics) module

operative learning processes. Accordingly scenarios of teaching-learning situations are to be developed using texts, animations and video etc. It is intended that these will set the contexts, present the problematic nature of the teaching-learning situation and act as a catalyst for raising problem questions with a view to fostering discussion, further research and background reading. Further research will be facilitated in the Web-based environment by the use, amongst other sites, of the MATHDI (MATHematical DIdactics) database. This is a highly comprehensive database of

research on mathematical didactics, developed by the Zentralblatt fur Didaktik der Mathematik in co-operation with the European Mathematical Society. In addition further background study will be facilitated readings and guided readings around theories and practices of teaching-learning and the nature of mathematics. Discussion and co-operative learning processes will be fostered via the use of computer and video conferencing.

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Preservice and in-service training of science teachers: integrated approaches towards science teaching and some implications for teacher education

Abstract

This chapter focuses on the development of provision, in terms of the contents and methods, of the programmes of pre-service and in-service teacher education of science teachers at the Italian compulsory school level (primary school and middle school: pupils between 6 and 14 years of age). Particular attention is given to the educational strategies and didactical methodology on which this development is based. Integrated approaches to science teaching and related problems are discussed. Integrating principles, dimensions of integration and the profile of the mathematics and science teacher are outlined.

Preservice and in-service training of science teachers at the University of Pisa

In recent years the University of Pisa Didactics of Chemistry and Integrated Sciences Research Group has participated in in-service and pre-service training activities in collaboration with several institutions (IRRSAE Tuscany, M.P.I., Rettorato of Pisa University, etc.)

In-service training activities

At the elementary school level

In Italy, new programmes were introduced into elementary schools in September 1987 and science teaching, for the first time in the history of our schools, began to play an autonomous role (Bargellini *et al*. 1989; Bargellini 1991; Bargellini *et al.* 1991). The new science programme is based on the following five themes: physical and chemical phenomena; the environment and natural cycles; organisms: plants, animals and man; man and nature; the man-made world. Starting from these programmes, in the pluriennial in-service training programme for elementary school teachers, we tried to attain the following objectives and to develop the following content:

Objectives

a) Acquisition of a minimum, but correct, level of chemical language.
b) Acquisition of some basic chemical concepts, in relation to children's cognitive development.
c) Acquisition of knowledge of some chemical processes.
d) Acquisition of first level of awareness of the importance that chemical knowledge plays in the relationships between people, society and the environment.

Content

a) Content relative to the structure of chemistry;
   i) Physical states of matter;
   ii) Changes of state;
   iii) Systems (mixtures and solutions);
   iv) Chemical substances (with particular reference to their danger and toxicity);
   v) Chemical interaction;
   vi) Acids and bases.

b) Relevant chemistry content

This is relative to the relationships between chemistry, society and the environment, and concerns the great problems of contemporary society: health, environment, food, energy resources, etc.

c) At middle school level

In accordance with Ausubel's theory the following six units of instruction were prepared and experimented with in some Italian middle schools (pupils 11–14 years of age):
   i) The physical states of matter
   ii) Changes of state
   iii) Solutions
   iv) Elements and compounds
   v) Chemical interaction
   vi) Acids and bases

Pre-service training activities

During the academic years 1994–5 and 1995–6, in view of the creation of a school of specialisation in teaching of two years duration, the University of Pisa organised two specialisation courses (see Bargellini *et al.* 1996).

These two courses, which aimed to promote the professional training of future teachers at upper and lower secondary school levels, partly by means of teaching practice activities, dealt in particular with aspects related to subject-matter didactics. The courses were attended by newly graduated students in the following subject fields: Italian and Latin, foreign languages, mathematics and computer sciences, natural and experimental sciences.

The didactic activities involved the following: the science of education; teaching of a historical and epistemological nature; teaching of subject didactics, integrated with specific laboratories and related teaching practice. The second course, whose programme is indicated below, was held from 30 January to 29 June, 1996 and involved 200 hours of lessons, 90 of which were attended by all the participants and covered general pedagogy and didactics, the psychology of education, and developmental psychology, learning and behavioural difficulties.

In this case, as in the previous one, there were a number of special studies for each class with seminars, guided practical activities and teaching practice in selected schools with the support of tutors. Each subject took into account the specific aims of the course and encouraging maximum levels of participation by the students who were involved in group activities, seminars, group and individual projects. At the end of the courses the participants took written and oral examinations for evaluation purposes.

The courses were based on didactic-methodological procedures previously discussed and agreed upon by the various course lecturers, in the presence of tutors and a number of representatives of the psycho-pedagogical area.

The practical teaching activities were conducted in such a way as to allow the student teachers to act first as observers and then to carry out a gradually more active role as protagonists.

Inevitably, a number of inadequacies were observed, in particular with regard to:

i) the level of coordination between the various subject areas, between these and the practice teaching activities and, above all, between the subject area and the psycho-pedagogical area;
ii) the limited number of hours dedicated to teaching practice and their unsuitable timetable;
iii) coordination, with reference to content, between course programmes and the programmes carried out in the schools which hosted the practice teachers.

These problems, however, despite not undermining the good quality of the experience, do need to be solved.

Educational strategies
The materials proposed in chemistry for these activities were prepared on the basis of research carried out over many years with teachers and pupils. The strategies followed required the teachers to carry out the experimental activities designed for children working in pairs.

The laboratories or the classrooms were organized with low-cost, flexible and safe materials.

Didactic methodology
The didactic methodology followed was based on D.P. Ausubel's theory and followed the method of guided discovery in order to reach significant learning. According to this methodology, the teacher, suggesting the treatment of content relating to the various sections, leads his/her pupils gradually to acquire basic scientific knowledge and concepts and to have a certain familiarity with the scientific procedures of investigation that are used in the solution of simple problems that arise in everyday life.

The pupil, placed in a stimulating situation, is guided to observe objects and organisms, to discover the properties of the former and the relationship between structure and function in the latter, as well as the relationships that link them to the environment in which they live.

The role of the teacher during these experimental activities is that of following his/her pupils as they work in pairs or in small groups, guiding them in their observations and enquiries and stimulating them to continuous critical thinking.

During more recent activities, the methodology has been more markedly constructivist.

The problem of integration between experimental sciences

Conclusions of the Varna Conference on the integrated teaching of science
In 1968 an important International Conference on the Integrated Teaching of Science was held at Varna (CIES 1968) some of its conclusions follow:

1. The teaching of integrated science contributes towards general education, emphasises the fundamental unity of science and leads towards an understanding of the place of science in contemporary society. It avoids unnecessary repetitions and permits the introduction of intermediate disciplines.

2. A course of integrated science should emphasise the importance of observation for increased understanding of the environment; it should introduce pupils to logical thinking and scientific method.
3. The extent of integration and the balance between integration and coordination will depend on the age of the pupils, the type of educational institution and local conditions. At the earlier stages of secondary education, a totally integrated course in experimental science appears generally desirable. At the higher stages of secondary education such a course may also be desirable especially for those students who have decided not to specialise in science.
4. Science is an important part of primary education, particularly in arousing scientific curiosity and in developing scientific attitudes and skills.
5. Studies into concept formation in science should be carried out, principally for the younger children.
6. Further experiments in the development of new integrated curricula and the production of teaching materials are needed, drawing on those resources that are already available. The results of such experiments must be widely disseminated.
7. The training of teachers for primary schools should include science closely linked to pedagogical aspects of teaching science. Secondary teachers should receive an education in science at university level and this education should include pedagogical aspects, both in theory and practice. In-service training, both scientific and pedagogical, is considered to be essential.

The integrated teaching of experimental sciences: motivation and objectives

Gadsen, Becht and Dawson have analysed over 100 projects for the integrated teaching of experimental sciences, prepared in various countries throughout the world, examining in particular the motivations and objectives of the projects examined (Gadsen *et al.* 1979).

The motivations include the following:

i) the conviction that the understanding of each single scientific subject area requires an external contribution: for example, the teaching of biology requires the application of a number of chemical notions, which in turn are related to the knowledge of physical knowledge and laws;

ii) an awareness of the fact that the quality of scientific teaching can be improved: in order to make progress in the field of integration it is, above all, necessary to examine traditional didactic methods critically and renew methods and contents.

The same authors have also recognised 23 types of general objectives and have attempted to classify them into five basic groups (objectives related to themes of a scientific nature, objectives related to personal growth, objectives of social relevance, objectives of personal interest, general education objectives).

The interdisciplinary aspect of science corresponds, therefore, to the requirements of present-day society to educate individuals in a harmonious and balanced manner. Every discipline, due to its links with others, contributes to the realisation of this objective.

This basic aim has inspired many of the integrated science teaching programmes prepared in recent decades. These, however, present marked differences with regard to general and specific objectives. As it is impossible to present a general overall view which takes into account the diversity of declared objectives in the projects examined by Gadsen, *et al.* 1979, it would seem useful to draw the attention of teachers to a particularly complete reference model presented in one of the didactic units contained in the English project 'Science 5–13' (Macdonald Educational 1972–75) and aimed

at the elementary school level, although at the same time it could also be applied at the Middle School level.

Integration principles

We could easily be encouraged to think of content as the main integrating principle: topics such as, for example, water, air, the environment, are by their very nature interdisciplinary. Content however, does not constitute the only possible integrating element.

The same function can be carried out by:

a) common pedagogical objectives, like the acquisition of the capacity to analyse phenomena in science, in mathematics, in history;
b) the adoption of a common methodology, based for example on the acquisition of concepts and the activation of procedures that are basic to experimental sciences. Tables 1 and 2 indicate the most important scientific procedures and concepts according to an elaboration by the American Association for Advancement of Science (AAAS).

Table 1. Procedures followed in science (AAAS)

Observation: use of the senses to describe objects and phenomena **Classification**: to choose, group and order on the basis of particular criteria **Numerical relationships**: to identify quantitative relationships existing in nature **Measurements**: to measure various sizes; collection of data, evaluation, precision **Time-space relationship**: description of spatial relationships and their variation in time **Communication**: oral, pictorial and written **Inference**: simple and plausible explanations of an observation **Prevision**: to make previsions of the type: "what would happen if …"	**Formulation of a hypothesis**: the use of observation, inference, prevision, etc. to suggest explanations of wider generalizations. **Produce operative definitions**: to define terms and objects in the context of a certain experience. **Identify and control variables**: to consider all variables but vary only one at a time in order to identify unequivocally the relationships with the system. **Experiment**: to formulate hypotheses, control variables, invent procedures, communicate. **Interpret data**: what do the data mean? What generalizations are possible? What further experiments are necessary?

Table 2. Some of the principal concepts in science (AAAS)

Cause-effect	Matter-energy	Cycle	Model	Entropy	Probability
Equilibrium	Organism	Evolution	Population	Field	Scale
Force	Space-time	Interaction	Symmetry	Order	System

Dimensions of integration

Among the various dimensions that characterise integrated science teaching programmes, are amplitude and intensity.

Amplitude depends on the number of disciplines that come into play in the integration process. A scale of growing amplitudes can be established, for example:

a) within the scope of one of the natural sciences: for example in biology between zoology and botany;
b) between two closely related exact sciences: for example between physics and mathematics;
c) between natural sciences and social sciences.

Intensity, on the other hand, expresses the effective degree of integration between the disciplines considered.

At the Varna Conference the distinction existing between a complete integration process and one of simple coordination between disciplines was already clear. Today a much finer distinction between coordination, combination and synthesis (or complete integration) is proposed (Blum 1975; Bargellini and Fedi 1990).

The term coordination means the simultaneous teaching of independent programmes under the direction of a common body, for example a coordination committee.

Instead, a combined programme includes didactic units that are programmed around large-scale themes referring to different disciplines. In a programme of synthesis a problem of an interdisciplinary nature is used as the unifying idea of the didactic unit. In order to determine the degree of integration characteristic of a certain programme, use is generally made of an integration matrix defined in terms of the dimensions of amplitude and intensity.

Towards a school of specialisation for teachers in Tuscany: a plan for science teacher training

In preparation for the introduction in Italy of a school of post-graduate specialisation, of two years' duration (foreseen by a law passed in 1990 but not yet in force) the two previously-described teachers' training courses were held at the University of Pisa. The academic senates of the three Tuscan universities in Florence, Pisa and Siena have also appointed a Proposals Committee to study the feasibility of the school in Tuscany. Some of the suggestions of the Proposals Committee on the teachers' training process follow.

Programming in the courses relative to the field of natural sciences (course 59/A), mathematical, chemical and physical science in middle schools.

University didactic regulations specify, as minimum requirements, the following:

Area 1: training as a teacher
Includes didactic activities aimed at the acquisition of necessary attitudes and competence in the science of education as well as in other related aspects of the position of teacher.

Area 2: subject-specific training
Includes didactic activities aimed at the acquisition of attitudes and competence relative to didactic methodology for the corresponding subject, with particular attention to the logical aspects, the genesis, historical development, epistemological implications, the practical meaning and the social functions of each branch of knowledge.

Area 3: laboratory experience with specific reference to the training content of courses

Area 4: teaching practice

Profile of the teacher

It is extremely difficult to define such a profile in the present day when there is debate on the re-organization of study cycles. In any case, in relation to the current situation in the middle school, it can be suggested that the most suitable profile for a mathematics and science teacher is one corresponding to a single teacher, that is, one who has more specific training in two subjects than in the others, as happens in many European countries. This model should allow for more weight in the subject training sector and the acquisition of more specific competence in the field of the chosen subjects.

The training of this single teacher can be described as follows: the student will have a preparation (subject-based, in subject didactics and of epistemological nature) in two of the five subjects involved in the present ministerial programmes: 1) Mathematics with elements of computer sciences; 2) Biology; 3) Physics; 4) Chemistry; 5) Earth sciences.

For students who are not graduates in Mathematics, Physics or Chemistry, one of the two subjects studied A, B, must necessarily be mathematics. The relative preparation will require an increased length of time for theoretical studies, laboratory activities and teaching practice. The group of subjects in which the student will receive a more specialized preparation will be entitled “basic subjects”, while the group of other subjects will be called “other subjects”. Specific preparation will aim, rather than at a quantitative increase in the extension of knowledge of the chosen subject, at the development of critical capacities and methods in that subject. In particular a thorough knowledge of the structure, the didactics, the history and the specific epistemology of the two main subjects will constitute a significant general reference model.

Subject-specific training

Objectives

1. The objectives of teaching subject didactics and relative laboratories are respectively the acquisition and application of specific competencies in the determination of didactic objectives, in the choice of teaching content and in effective curricular organization, in the choice and collaborative construction of teaching strategies and the formative evaluation of the learning results obtained.
2. The objective of epistemological teaching is the acquisition of knowledge regarding the nature and development of subjects in preparation for the required teaching, the relationships between them, reflection on the nature of the teaching problems faced and on the methodologies of didactics research used.
3. For areas regarding epistemological teaching, subject didactics and subject didactics laboratories, the organization of teaching, didactics activities and formative activities is effected on a modular basis and is defined according to what is indicated in the School Didactics Regulations.

Content of the subject based courses

The courses considered to qualify are the following topics. They may be subject to further refinement within each category:

Subject didactics

Aims and objectives in teaching
Role in the teaching of a specific scholastic stage
Interaction between learning theories and subject didactics
Didactic treatment of conceptual key points
Didactic technologies, instruments and models

Interaction with other subjects within the context of the curriculum.
Criteria and methods of evaluation of learning
The teacher as researcher

Epistemological bases of the subject
Role in knowledge
Significance in cultural formation
Critical historical development
Conceptual key points within the subject
Language and communication
Instruments, models and methods

Definition of the study plan
In order to obtain qualifications the subcommittee proposes the following study plan organized so as to minimize the total number of courses and at the same time both to leave the student a certain degree of liberty and to favour the possibility of obtaining double qualifications.

Credits
The subcommittee suggests offering credits to any student who has included in his/her degree study plan examinations whose contents correspond to those of the courses offered by the school. In this case the student can obtain credits for corresponding courses or modules, possibly presenting for an integrating test that will be evaluated by a School Board commission.

Minimum requirements and 'debts'
The subcommittee also examined the problem of relevance of knowledge acquired in various degree courses that allow access to the various limited-number classes and therefore proposes a number of suggestions to allow the enrolment of candidates who present subject insufficiencies ('debts').

To that end the commission has listed the subject competencies that are held to be necessary for the particular specialisation so that the future teacher will, at least initially, have adequate knowledge of the subject to be taught.

Students who have acquired all the required competencies during their degree course can enrol directly, while those who have insufficient knowledge ('debts') must complete their relative knowledge. The Board will indicate in these cases what form the completion is to take. Generally speaking this will require attendance at suitable university courses. It is suggested that special conventions be agreed with the faculties concerned; qualification to appropriate level will be validated either by passing the university examination for the course, or by a special examination by a School Board commission. (The latter may be necessary where the university course or relative examination is of a higher level than that required for qualification.) Clearly those students who wish to enrol for two specialisation classes simultaneously must satisfy requirements for both classes.
a) Subject areas and training activities
a) the subject areas corresponding to the five previously mentioned subjects
b) all subject didactics
c) subject didactics laboratories
d) historical-epistemological foundations regarding the two chosen main subjects.

b) Details of the proposed training and time allotments
To allow increased flexibility of individual didactics programmes it is proposed to group the didactic activities in quite brief modules (from 10 to 30 hours). The 220 hours available for the subject area are as follows:

1st year

1st Semester

Basic subjects

Didactics and epistemology of subject A	30 hours
Didactics and epistemology of subject B	30 hours

2nd Semester

Basic subjects

Didactics and epistemology of subject A	20 hours
Didactics and epistemology of subject B	20 hours

Other subjects

Didactics of integrated sciences	20 hours

2nd year

1st Semester

Basic subjects

Didactics and epistemology of subject A	20 hours
Didactics and epistemology of subject B	20 hours

Other subjects

Didactics of integrated sciences	20 hours

2nd Semester

Project area

Curricular development of models and didactic units regarding the topic and requiring an integrated scientific vision	40 hours

1st year

1st Semester

Basic subjects

Subject A didactics laboratory	25 hours
Subject B didactics laboratory	25 hours

2nd Semester

Basic subjects

Subject A didactics laboratory	20 hours
Subject B didactics laboratory	20 hours

Other subjects

Integrated sciences didactics laboratory	20 hours

2nd year

1st Semester

Basic subjects

Subject A didactics laboratory	20 hours
Subject B didactics laboratory	20 hours

Other subjects

Integrated sciences didactics laboratory	20 hours

2nd Semester

Project area

Experimentation in curricular key of modules

and didactic units regarding a topic that requires an integrated scientific vision 30 hours

Laboratory experience with specific reference to the training content of courses

Organisation, management and operation of the laboratory

The operation of the laboratory, and the management of the 200 hours of activity that are to be carried out by the students in a particular course, are entrusted to a team consisting of the following persons:

1. A number of teachers of didactics in the various subjects making up the area (mathematics, computer science, chemistry, physics, biology, earth sciences)
2. A formation sciences teacher
3. An expert secondary teacher (supervisor)

The organization and management of the laboratory activities are entrusted to one of the subject didactics teachers.

Laboratory activities

Laboratory activities include the following:

a) Planning of didactic modules
b) Planning and preparation of didactic materials (complex and low-cost equipment, models, transparencies, cards, slides, video), aimed at experimenting in the planned modules.
c) Comparison of alternative didactic hypotheses
d) Critical analysis of:

- text books
- cards concerning the various stages of curriculum development
- video
- didactic software
- modelization processes and types of model used in the didactics of various subjects making up the course

Teaching practice

The programme for the 280 hours of teaching practice is as follows:

After taking part in the laboratory activities, the student-teacher is assigned to a specially chosen expert teacher (tutor). In a laboratory school, previously selected and suitably structured, the student-teacher, under the tutor's guidance, carries out two periods of teaching practice.

1st year

1st period of teaching practice (passive) (100 hours)

During this period the student-teacher mostly follows and observes the tutor's activity assisting him/her in the programming of modules and didactic courses, as well as in the preparation of all the didactic material necessary for their realization.

2nd year

2nd period of teaching practice (active) (100 hours)

During this second period the student-teacher continues to assist the tutor in his/her various activities, at the same time assuming the role of active teacher. During this second phase, as well as didactic activities, the student teacher is engaged in didactics research (80 hours).

On conclusion of the two teaching practice periods the student-teacher should have acquired professional ability/expertise in the following:

a) the ability to communicate in scientific language
b) the ability to effect observations
c) the ability to solve problems of an experimental nature
d) expertise relative to the historical evolution of the experimental sciences
e) awareness of the influence exercised by the development of science on society and the economy
f) expertise relative to health and the environment

Functions of the supervisor or teaching practice coordinator
The supervisor, who will be responsible for not more than 7–8 tutors, carries out the following functions:

1. Participates in all the activities concerning the planning of didactic materials carried out in the laboratory
2. Informs the tutors on the didactics-methodological and content aspects of the models elaborated and experimented within the laboratory
3. Is in contact with the tutors and coordinates them, partly with a view to evaluating the teaching practice activity carried out by the students.
4. Together with other members of the team, participates in the evaluation of the teaching practice carried out by students.

Functions of the tutor
The tutor is an expert teacher in the subject area and is responsible for following no more than two student-teachers during both their passive and active teaching practice activities.

Furthermore, the tutor collaborates with the teaching practice supervisor in correlating the laboratory and teaching practice activities and in formulating a final evaluation on the level of professionalism reached by the students in relation to the activities carried out during the two teaching practice periods.

Relationship between laboratory and teaching practice activities
During the teaching practice activities the modules elaborated in the laboratory are experimented with in the pilot classes by the student-teachers under the guidance of their tutors. Following the experimental activity in class the modules are discussed in the laboratory to undergo critical analysis and eventual revision in the light of experience, before becoming definitive.

Final report
On conclusion of the training programme, the future teacher will prepare a final report on the fundamental aspects of both the various didactic activities and the research activities carried out.

The plan proposed in this programme provides for attendance at a minimum of two semester courses on “foundations and methods in two subjects of an experimental nature” (to be chosen from Biology, Earth Sciences and Chemistry), for graduates in mathematics and physics.

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Sources of 'didaktization'. On defining disciplines and their '(fag-)didaktik' across borders illustrated with examples from Mother Tongue Education (MTE)

Abstract

This is not a traditional paper, but rather a collection of pre-thoughts about challenges of generalizing school disciplines and their didaktik across borders of languages and cultures. (The written, made up form, 'didaktik' is chosen in this paper to keep a certain distance from 'didactic' as derogative.) The point of departure is Mother Tongue Education (=MTE). However there are short visits to other disciplines, such as science. Examples and perspectives are mostly taken from Norway and Scandinavia. There is no main idea, or coherent thread of thought, other than to try to avoid seeing a discipline as a straightforward phenomenon. The paper has no intention of covering all relevant problems, but focuses on the internal relationship between a discipline and its didaktik. One hypothesis is that defining a discipline is the moment of birth for its didaktik, and that through the inevitable 'languaging' of this ongoing process, there is established a, so far badly recognized, important relationship between the didaktik of MTE and other disciplines and their didaktik. Internal challenges in the didaktik of MTE could therefore serve as a source of reference for other disciplines.

Introduction

I will define didaktik quite simply as questions about a discipline or a field. In the late 1990s didaktik has gained more attention in Scandinavia, there is an increased interest in it, more books are published and the variety in topics and concerns is significant.

Traditionally didaktik has been seen as a relatively stable relationship between an educational content (what) and its methods (how) and legitimation (why). This paper widens the scope by searching for different sources of didaktization. This does not imply that established aspects are refuted or disputed, but rather is intended to add new questions to the tradition.

The 'outspring' is language, especially Mother Tongue and Mother Tongue Education (MTE) in a non-national perspective. MTE in most countries will consist of much more than language, but these aspects will not be discussed in this paper. I start from the question of classification in general and then in relation to concepts within the field of 'Norwegian'.

Further I try to show, quite simplistically, how three basic aspects of language function as sources of ideologies within MTE over the years. As the importance of all three aspects (form, content and use), grows, the didaktik is growing too. This is a growth mostly from within, since the natural question after periods of strong expansion is inevitable. What is MTE? The 'what' question is seen

as an original source for didaktization, irrespective of whether a field has something to do with education or not. This view makes the question of didaktization a general one, which will move didaktik closer to Wissenschaftstheorie, epistemology, meta-cognition and philosophy.
I progress by inspecting briefly some traditional sources of didaktization. I then dwell on the problem of didaktik as additional or inherent to a discipline, suggesting that this is a crucial, undertheorized problem in teacher education today. I further suggest that didaktization is deeply rooted in culture and in fundamental changes of the conditions for production and reproduction in society. Accordingly didaktization is seen as a symptom of conflicts between modernity and postmodernity, and is linked to the use of (models of) language to obtain educational reflexivity.

Finally I outline a triadic understanding of the didaktization of knowledge, teaching and learning, related to a triadic view on language and communication. The triadic view is in line with the three general aspects of language pointed out above: form, content, and use. This approach can function as a frame of reference for and between disciplines and their didaktik, not least across borders.

Classification of (and with) cultural objects, such as MT?

With the introduction of the so-called Metric System an attempt was made to overcome the problem of worldwide standards for measures. Even if it should apparently be relatively easy to define physical concepts, and in spite of strong general agreement on the benefits of a shared, common system for reference, its introduction has progressed quite slowly, due to the strong cultural traditions in many countries. Similarly, the Norwegian Association of Ornithology has this year been able to agree upon a system of standards for referring to different parts of birds' bodies, in order, as is noted, to avoid "unambiguous" concepts.

However birds, like our topic Mother Tongues, differ in types and forms, and they move across borders. They are also studied and referred to by international communities of researchers. Plants, animals and other natural objects are traditionally referred to in Latin. Whilst the metric system goes against tradition in the Anglo-Saxon world regarding vocabulary as well as long held standards, the situation in new academic fields, such as comparative studies in education, is rather different. English, and the inherent ideologies that go with it, cannot be avoided though. What we are confronted with are not objective categories but cultural phenomena as focused 'objects'. And further, another cultural phenomenon, the English language, is used as a tool. In addition speakers and listeners will, in most cases, be non-English, which implies that in the process there will normally be two mental 'translations' as well. So much for the risk of being misunderstood in describing the discipline ideologically when making studies across borders by means of language.

As can be seen, there are dilemmas in taking an 'international' perspective: A semantic system or a cluster of concepts is surely needed. Too much 'precision' however may turn out to be inadequate or may even falsify the nature of the phenomenon in question. 'Neutral' concepts are of course preferable, but English, which in practice is the only alternative, constitutes an implicit ideological standard (as would any other language). The 'values' of the local or national concepts disappear, to be replaced by the 'values' of English. In Norwegian it is possible to say 'Førsteskriftspråksundervisning' in one single word, that is, in one 'concept', not 'con cept'. Such a construction creates problems for English. ('First-written-language-teaching'?) Or, for example, a term such as 'fagdidaktikk' creates double trouble since both 'fag' (German, Fach) and 'didaktikk' seem to be untranslatable in English. And finally, two recently established international research journals have been called *English for Specific Purposes* and *Changing English*. The names are of course perfectly acceptable, except for the fact that both journals welcome research reports in languages other than English.

The 'flora' of terms referring to different 'languages of Norway' over the last two hundred years (which is a deliberately imprecise use of the preposition 'of'), illustrates the kind of cultural and logical phenomena we are confronted with in aiming at 'precise', general definitions: dansk, dansk-norsk, norsk-dansk, norsk, landsmål, bokmål, nynorsk, riksmål, samnorsk, dannet østnorsk, modersmål, morsmål, førstespråk, hjemmespråk, sidemål, hovedmål, samisk. This mixture of terms would be confusing to most foreigners, even if the terms were translated properly. This true variety of partly related, partly synonymous, concepts will get lost in the moment of chosing one concept to cover the 'something' in question, which is probably not a 'thing' (a category) either, or not even *one* thing.

In 1962 *Swedish* took the term *modersmål* (English, Mother Tongue) in Swedish written curricula to describe the discipline we are investigating (Svedner 1999: 26). In Bulgaria the discipline was called *Bulgarian language* until 1981, when for a short period it was called *native language*. In 1990 the name was changed again, but now to *Bulgarian language and literature* (Kütchukov 1995: 202–203). In Norway *Norwegian* was in use from 1889. The decline of the term *modersmålet* should be understood in connection with Norway's striving for national independence from Sweden at that time.

When the National Association for the Teaching of Norwegian was established, as late as 1977, its proposed aim was quite simply "to strengthen the subject of Norwegian" (Ongstad and Smidt 1995). However after a quite heated debate the following was added, "(...) *with complete respect for Sami as an independent mother tongue"* (given the fact that the Sami people had lived within Norway's borders thousands of years before Norway was even a concept or a state). However a possible contradiction was just around the corner: *Sami is Norwegian* (!) Can this tangle be resolved through verbal clarification? Sami is a language indigenous to the state of Norway, and in that sense a *Norwegian language*. However, since Sami is the only indigenous language in Norway that is not a linguistically Norwegian *rooted* language, it holds legal status as an independent 'Norwegian' mother tongue (as distinct from all the other, approximately 100, mother tongues) spoken and taught in Norway by immigrants.

On the other hand, since the name of the *curricular* discipline taught in schools is also *Norwegian*, a logical consequence, when editing a new national curriculum, would have been to call the discipline MTE, under which Sami, Nynorsk (New Norwegian) and Norwegian would be listed as separate language forms to be taught. (On 'Nynorsk', a special Norwegian phenomena, see Ongstad and Smidt 1995.) However, this would not be right either, since the educational discipline of course contains much more than the teaching of a particular language. This extensive part, containing crucial subject elements such as literature, media, and ICT, is hardly 'mother tongue' in a strict sense, or at least only just indirectly related to it. And finally, to increase the confusion, in the new written curricula for years 1–10 for all compulsory schools in Norway, the so-called L97, there is not a word about Sami as a separate discipline, presumably based on the quiet argument that Sami is now in some sense an independent education, and in spite of the fact that the new curricula are in force for all children in Norway (KUF 1996). In the 1987 curriculum, M87, the two disciplines are listed together with other related curricula. This implies the following three terms: *Norwegian, Sami as First Langue, Mother Tongue for Language Minorities* (KUF 1987).

Crossing borders, these and similar ethnocentric labels and terms become impossible as shared notions for the phenomenon in question. Thus some sensible possible explanations can be developed. The International Association for Applied Linguistics (AILA) uses the terms Mother Tongue and Mother Tongue Education, which are even used by a subnetwork within the association. There are at least two problems with MT(E). Firstly, some feminists refute gender related concepts such as

'*Mother* Tongue'. Secondly, there is already confusion in some countries because the term MTE is even used for the education given to students who are taught their 'own' language as a minority language. 'Morsmålsundervisning' in Norway cannot be used in isolation any longer. More and more people will, without a context, interpret Mother Tongue Education as teaching for students who do not have Norwegian as their main language. The problem is that reality is too complex for the words available. It is not possible to be 100% precise. A *native* speaker or a speaker of *a native language* implies an "either/or thinking", and does not allow for a mixture of 'native' languages in the geographical area nor for different degrees of bilingualism. On the other hand the term MTE is common, established and widespread.

Four possible different alternatives to mother tongue: *native* language, *first* language, *home* language and '*own*' language, all have different semantic implications and emotional connotations. They will probably classify differently as criteria in different situations. For some people their *first* spoken language will never become their *first* written language. *Home* language may not mean *first* language. *Mother* tongue may actually be *father* tongue. To decide about the labelling of these things is not a personal or national question. It is an *international dilemma* where objective precision has to be balanced with practical functionality. In this paper I will stick to the term MTE, while, however, being open to its possible weaknesses.

MTE as historical ideologies of form, content and use

Form

Basically a historical core for MTE in many national states was to bring the child to understand that the specific sounds of spoken words corresponded with the written letters in a systematic way. The proper reproduction of the national 'sound' was at the heart of the enculturation. To be able to recognize the words, the learner had to learn their meaning. To grasp the meaning of the words, the child had to understand their use. To comprehend the total sense, the student had to know the use of words within the specific culture. However, it took more than a hundred years to develop these related recognitions, in their deepest sense, as theories of language and learning, and as adequate elements in written curricula.

To be able to produce the right sounds has been a dominant ideology. The actor in the national theatre, the priest in the pulpit, the gifted speaker in the national assembly, the reader of the news on radio and television, the teacher in front of the class: all were expected to produce the proper sound, and thus confirm and transmit the 'nation'. The same held for the written language. Hence school systems in national states have put an enormous stress on the reproduction of a correct national *form*.

However, in nations with older cultures, such as China, Russia, France and England, the sound system had drifted away from a written language that was established early, while 'younger' nations, such as Finland, had a rather orthophone situation, with a short distance between sound and letter. Reading and spelling became the curricular tools to recreate nativeness such as 'Englishness' and 'Norwegianness'. In many countries this aim was blurred by the fact that particular sociolects and dialects had won in a social and political battle to become, or to control, the national language, normally the cultured elite in the capital. ("A language is a dialect with an army.")

This aim has, in some countries, for different reasons, been the dominant factor in what is considered as MTE up to the 1970s. The language, the MTE curriculum and the nation are one. Everywhere where real members of the nation are visible and audible, the correct patterns of speech should be expected. Serving the switchboard in the company, applying for important jobs, writing for the public in newspapers, talking to middle class kids in schools, should be in the appropriate language.

The first signs of cultivation would appear through the language people used as standard forms. The forms were significantly national. When the lower classes, people from rural districts and immigrants, streamed to the towns and cities to get mass education and later on higher education, they had to leave their own sounds, their particular forms of speech, behind and adjust to those of the nation, guarded by the teachers of MTE.

The dominance of this ideological paradigm is now broken, but not its power. If immigrants cannot sound and look Norwegian in their 'verbal appearance', they will, even in 1999, *not* get a job, as a rule, where language is involved. A symptom of the situation is that most right wing parties in European countries still defend the prime position for a 'proper' language. An interesting tendency is that some applicants, fluent in written and spoken Norwegian as second or third generations of 'immigrants' in Norway, but with 'un-Norwegian' skin colour, names and sound, have started to take Norwegian looking names in order at least to get as far as an interview. Norwegian form is still valid and crucial. MTE didaktik generally avoids discussions of this topic.

Content

Norway is not Denmark. There are Norwegian words for Norwegian phenomena, *ski, quisling, fjord*. The uniqueness of a nation has often been connected to some believed core patterns in the national culture. To support this semantic process the textbooks in many countries, especially in the first part of this century, were filled with iconic national texts, such as the heroic lives of brave men and the humble everyday work of women. Through this process a national 'world picture' was smuggled in. The conceptualization of the phenomena has taken on a national character, mostly without saying so, in short, it is *ethnocentric*. To establish coherence, and not just particularity in this respect, *history* is used, and notably not only in the discipline of history, to focus on the creation and recreation of the nation. Searching for the content of MTE around the world we will find the story of the language, the story of the literature, the story of the people, the story of the glory, the story of independence.

Use

The third aspect that came into the national curriculum arrived in a sense relatively late. In some situations it was necessary to *act* in a certain 'national' way. Lord Nelson told his soldiers what England expected at the battle of Trafalgar, the little Dutch boy put his finger in the hole of the dyke to save the land, Jan Palas burnt himself to death in the streets of Prague and the prime minister of Norway, Gro Harlem Brundtland, promogated bluntly the slogan "It is typically Norwegian to be clever" after the Olympic Games at Lillehammer in 1994. However acting 'Norwegian' cannot normally and easily be controlled and evaluated in schools. The form and content of Norwegianness can easily be measured, but not its *use*.

Form, content and use in research

Parallel with the above developments, research on language developed a new understanding of the 'nature' of verbal phenomena. Saussure showed that the number of sounds or phonemes were actually quite limited and formed an oppositional system of differences. The national languages and the dialects used certain phonemes that were particular to a language only by difference. This system in fact underlined the similarities between human beings and their speech rather than the differences. Later Chomsky showed that grammar rules were restricted too, and that the basic elements of the syntax of verbal language were common to all human beings. A specific language was only specific in the *choices* it had made of a restricted menu of grammatical possibilities.

Semantics followed up what had happened in the linguistic study of syntax and grammar. Vladimir Propp, Louis Hjelmslev and Algirdas Greimas developed a more structured semantics. Although semantics has not been so successful as syntax in universalization and generalization of the field,

there is no doubt that semantics has been very important for new understandings of content, sense and meaning. As an example, all Norwegian students since the 50s have had to study logic and some semantics as part of a compulsory, propaedeutic first semester study. Generally it could be fairly said that *general* semantics has taken over from a more nationalistic way of thinking. This is clear from the topics of textbooks on language that came into use in the late 60s and early 70s in most European countries.

Finally, Halliday has more recently shown how the use of language follows patterns that can be generally described as *functional grammar* and where the cultural context is crucial for establishing meaning (Halliday 1994). We are now experiencing Hallidayian writing of grammar for national languages, where the stress is on the general rather than on the specific.

Taken as a whole, the scientific study of language, that is, the study of syntax, semantics and pragmatics, has forced schools and education all over the world to balance the general and the uniqueness of specific national patterns.

(This is not necessarily because the general is more 'true' than the specific. There are many reasons why teachers, experts and politicians want general answers to problems and challenges. Among them is that this view is 'simpler' – all human beings can be understood by studying one. Furthermore: it is cheaper. Books on language can just be translated or, even better, printed in English for an 'international' market. Finally it is easier to handle in the curriculum. Goals can be standardized. Students, teachers, schools, disciplines and countries can be evaluated and compared. Standardization is in line with major tendencies in the production system and in politics such as homogenization (downplaying) of differences).

The shifts above are reflected both in the naming of the discipline and in the exchange of content elements of the written curricula over the last few decades. However the shifts have been rapid and extensive, and defenders of MTE, searching for a core and precise borders of the discipline, have asked: what is MTE, really? For instance, Peter Elbow asks in *What is English?* if the discipline has to become just a bin, into which new topics are thrown, and much less is taken out (Elbow 1990: 108–118). He is sceptical about grand unifying theories or methodologies as a core for the study and learning of English:

When I look around at the profession and ask if we have a centre, it seems to me that the strongest centre remains the traditional one that doesn't easily let go: English as the profession of grammar and literature, correctness and good taste. But when I turn away from these wide and dangerous speculations (...) I come up with this: perhaps we will gradually get a new cohesive focus on the productive dimensions of language (...). Perhaps English can end up being a discipline that is, above all, about making knowledge rather than studying already existing knowledge. (Elbow 1990: 117–118)

It is wrong to believe that the thrown-together nature' of MTE is caused by or typical of postmodernism. Elbow mentions Fred Newton Scott, who 100 years ago claimed that the most characteristic thing about English teaching was its unsettledness, arguing that it was fuller of unsolved problems than any other subject (Elbow 1990:118).

Applebee, who has studied the history of English holds:

Whether the model for the educational process has been growth in language, the four basic skills (reading, writing, listening, speaking), or the three basic disciplines (language, literature and

composition), some aspect of what teachers considered to be important has been lost, reemerging to assert its own values and undercut the basis of the reconciliation. Inevitably, the edges of the subject have blurred and wavered, creating for the teacher of English a perpetual crisis of identity. (Applebee 1981: 145–46, Elbow 1990: 118)

In Norway Bull (1991) has expressed similar doubts about an anticipated 'core' in Norwegian as MTE, arguing that there is no unity at the university level either. On the contrary 'Norwegian' at this level consists of clearly separated and independent disciplines. Professor in MTE fagdidaktikk, Geir Wiggen, argues, by differentiating between a more descriptive presentation of the discipline's *is* and a more normative *ought* or rather *should*, that Norwegian as MTE has to give away many of its new trendy elements and return to one of its points of departure, to Norwegian language (Wiggen 1993).

Ven (1995) analyses, in his dissertation, MTE in Holland in particular and in Europe in general:

The exploration of the relation between the school subject and the academic discipline also leads to an interpretation of mother tongue education as 'more': different social groups and different forms of 'cultural capital' make more and more, and sometimes contradictory, demands on mother tongue education (Ven 1996: 504).

Summing up the consequences of new orientations, Ven concludes differently from, and much more radically than, Wiggen: *I think that the pluriformity of mother tongue education must be perceived as a vital quality, as a vital means for homogenisation – and I am very well aware of this paradox.*. (Ven 1996: 505)

Elbow simply states, and even he is close to a paradox, that asking *what is English?* is not the question, but the answer. He says that his book is about a profession that cannot define what it is, and that this fact is not at all a scandal, but possibly rather a strength (Elbow 1990: v). I would argue that the question is the moment of birth for MTE *as* fagdidaktikk: In asking the 'what-question' it is no longer possible to keep separate MTE and its didaktik.

'Didaktization'

By asking 'what' a phenomenon is then, the phenomenon changes. If I ask who I am, I am probably not the same person after the question. By asking what a certain discipline is, that is trying to define it, we change the discipline by forcing upon it a self-consciousness it did not have. In this sense 'didaktization' starts from the what-question and is accordingly inherent to the discipline. This explicit self-understanding can only happen through language. In MTE there will probably be a better chance of accepting the didaktik as part of MTE, since the meta-cognitive aspect of language is also language. Thus understanding of texts even implies some kind of text pedagogy. At least MTE deals with different views of communication that might have a crucial impact on how didaktik is conceptualized.

'Didaktization' can start from many different sources. One way of categorizing is to see *methods*, *pedagogy* and the *discipline* as three different points of departure for 'fagdidaktikk'. I will use the Scandinavian countries as a simplified illustration of this point. In Sweden the 'fack-didaktik' is quite methodologically oriented. *Svenska i Skolan*, a journal for the teachers of Swedish as a discipline, reflects this by mostly giving advice and being concerned with the practicalities. Books on didaktik in Swedish as a discipline tend to put *methodological* more often in their titles. An example is *Svenskämnet & svenskundervisningen* (Svedner 1999). A reason for this position might

be that pedagogy as an academic discipline has been relatively strong in the politics of education in Sweden. Methodology has been developed into a separate academic field, recruited from skilled teachers with quite solid backgrounds in the discipline. Compared to Norway, Sweden could be said to have a relatively dependent fagdidaktik and a visible *metodik*. Teacher education colleges in Sweden have merged with the universities and the professors of education and pedagogy as a discipline have had the role of gatekeepers. Sweden could thus be said to be a country where 'fagdidaktikk' has mostly been based on 'metodik' (methods).

In Denmark the teacher education colleges are not supposed to be research institutions. Power has been in the hand of the universities and, in Scandinavian terms, a rather significant institution, *Danmarks lærerhøjskole* (DLH). DLH has more or less had the monopoly of advanced education and research in Danish teacher education. The *fagdidaktik* in Denmark has been less visible than in Norway. On the other hand the pedagogical researchers at DLH have been able to problematize many aspects of didaktik through their extensive series *Didaktiske studier*, of more than 20 volumes edited by Karsten Snack between 1992 and 1996, in which four volumes were also published on *Læreruddannelsens didaktik*. Mostly challenges and problems are seen from the perspective of pedagogy and, to summarise, the content of the books may indicate that a significant, separate 'fagdidaktikk' in the disciplines developed into professional fields are not common in Denmark. This suggestion is supported by a clear tendency in the new law of 1998 for teacher education in Denmark, in which 'fagdidaktik' seems to play a minor role (Undervisningsministeriet 1998). Hence Denmark may serve as an example of a country where fagdidaktikk has been dependent on pedagogy and educational research. (However there are certain tendencies *within* the disciplines. See Henningsen and Sørensen (1995) regarding MTE-didaktik).

In Norway the situation is different for several reasons. In disciplines such as Norwegian, Science and Mathematics, *fagdidaktikk* is relatively strong. Partly as a symptom, partly as a reason, one could point to the fact that there are now masterstudies and professors in fagdidaktikk for these disciplines in Norway. Hence Norway serves as an example of a country where fagdidaktikk has mostly developed from the disciplines.

'Didaktization' seems to be an increasing tendency in North European education. On one hand it tends towards *particularization*, more often focusing on specific fields such as subfields of an etablished didaktik-discipline, for instance 'text didaktik'; or on the other hand, it focuses on special educational problems such as "fåskoledidaktikk", which is a didaktik for very small schools which are not large enough to keep up 'normal' classes.

However at the same time there is a clear tendency to *generalization* and internationalization. This goes on at different levels, for example in the disciplines, where they see themselves as more general, more important than the acceptance they have gained so far. See, for instance, Sjøberg (1998) who claims that science is underestimated as part of culture, and that the role of the didaktik of science among others is to increase our understanding of how nature and culture are intertwined. (I will return later to his book.) On a 'higher' disciplinary level we can trace the first general 'fagdidaktikk' (Lorentzen *et al.* 1998). This book brings together the didaktik of such disciplines as Mother Tongue, Vocational Training, Social Science and Mathematics without accepting that this joint effort should be described as traditional 'didaktik', but rather as (general) 'fagdidaktikk'. Internationally, too, there is a search for a platform not only for researchers who actually use the term didaktik (Uljens 1997), but also for the possibility of bringing together fields with seemingly different terms/labels in the hope that they are conceptually similar enough to be discussed under the umbrella – *Didaktik and/or Curriculum* (Gundem and Hopmann 1998).

The problem of the degree of didaktization

Increased didaktization of a discipline can and should lead to the crucial question of whether the discipline should continue to be seen as the discipline *plus* didaktik, or as a *new* discipline which is neither didaktik nor the basic discipline. Australian teacher education for primary education has had a strong tradition of balancing the 'discipline' and its pedagogy, almost as a fifty-fifty blend. However this has never been called *didaktik* and, as in Norway, pedagogy (educational studies) has recently been downsized.

In Norway, as in Australia, the established school subjects taught in teacher education are seemingly the winners, since there is less space left for pedagogy. A difference between the two countries is that they are arriving at this outcome from different traditions, as may be the case for many different European countries in a time of change. Norway for the last 20 years has had quite a strong didaktization of Mother Tongue Education: there are formally established (three semesters) mellomfag and hovedfag (master studies) as pointed to in the didaktik of MTE and there are appointed professors in MTE *fagdidaktikk*. There is even a shared Nordic initiative for a doctoral in the field. The question however is whether this tendency will lead to a significant shift in the character of 'Norwegian' taught in teacher education so that the new discipline actually is *Norskdidaktik*, the didaktik of MTE, a balanced blend of the two aspects into a new discipline, or if the Australian tendency will win – a return to the basic discipline with stronger links to the university tradition.

The answer may confusingly be both, since there are strong voices for a future *split* of teacher education for compulsory education (1–10) into two separate studies, one for primary and one for secondary education. Primary education may then choose the MTE didaktik and secondary education may give priority to the discipline(s). The irony of 'didaktization' within the field of MTE may then be that it wins a Pyrrhic victory, by taking over totally at the lower level and losing what it might have gained in school orientation at the higher levels. However this may just be speculation. What seems clear though is that, at the moment, didaktization is an increasing force throughout Scandinavia, taking on different patterns in different countries.

Didaktik of science without science

A new book in the didaktik of science which has deliberately left out science, illustrates the potentional tension between the two (Sjøberg 1998). Sjøberg's book is entirely *about* the didaktik of science. Hence science is only secondary. On the surface it is a book that takes seriously the increased ambivalence towards science in society. On the one hand science is undoubtedly more important than ever and founding even more basic conditions for the development of new societal patterns. On the other hand there is a 'winter of discontent' about the negatives in the wake of its 'progress' and a growing belief that science could no longer be an unproblematic route to freedom and happiness. Basically Sjøberg argues that his book is didaktik in science as *allmenndannelse*, alluding directly to the German and Danish tradition in didaktik focusing on *Bildung*/*dannelse*. There is no reason for not buying his argument that science needs a renewed, deeper, more fundamental didaktik, especially considering the many epistomological and ethical questions in this field that should be brought together.

However it is possible to see his, and other, books on didaktik as spin-offs of postmodernity. His claim for *allmenndannelse* can then be seen as a means to re-establish a modernistic discourse, that has lost ground. For the didaktik of science this seeems to be the only solution if one does not want to follow Lyotard. (Never mind all the fuss around the so-called Sokal case.) However Sjøberg admits that even if it were to be possible to accept Popper's falsification paradigm for science as such, the didaktik of science belongs rather in the Social Sciences and the Humanities and will be

open for Kuhnian paradigmatic shifts. And perhaps that is exactly what we experience at the turn of this century. Sjøberg's further argument is that science is culture and cannot be cut off from it. Therefore a didaktik, even in science, is mainly a question of culture. It has not been, but it should be.

Didaktization and societal production of meaning in society

Based on ideas from Bourdieu (1989) and Lash (1990) I will outline some general, broad assumptions on the relationship between positioning, language, the production of meaning in society and didaktik. In small, traditional societies with stable relationships where culture is largly reproduced, the basic sense of life, work and activities will be taken as *doxa*, that is, tacit and unquestioned. In this kind of society, activity is primary and language secondary. There is no need for schools, MTE and (fag-) didaktik. Its system of meaning is the doxa, meaning is given. So is language. We are in a premodern society.

In societies where doxa is questioned, particularly through language, activity and language are on a more equal footing as driving forces in production and reproduction. Meaning is not given, but has to be established, basically through language. New culture is produced along with old traditions. School is needed for the production of new competence and the reproduction of traditions. Mother tongue gets a central role in school to negotiate the old and the new.

The didaktik has the task of legitimising this balance and fulfilling MTE's role as performer. Society is dynamic and *heterodoxic*, it is driven by change. Language is now seen as dynamic, and can bring about change. Both language and activity are important in production. Modernity is on its way.

However, societies threatened by extinction or modernism may have the power to strike back. The new meaning is denied by establishing the old one as true, but this time explicitly defended, through language, by *orthodoxy*, the right meaning. Schools become important to restore what is almost lost. The fundamental meaning system is renewed, but now outspoken. The didaktik is used to promolgate and defend the restoration process. Language is important, especially its reproductive capacity. Meaning is seen as fundamental and present, and is kept alive through the literal use of language. Language is crucial, since it is used to make the meaning explicit, to defend it, and to control it. Modernity is opposed.

Historically and at the present time, for nations as for people, as well as on different levels, these three basic types are found to be blurred and in a state of change. Therefore there is a fourth type of meaning, the *paradox*. When all these three meaning-types struggle for dominance, it is difficult to judge what is the 'right' meaning. Language can no longer be trusted, but has still to be used. Language is seen as ambiguous. Language, or rather semiotic signs, are now more economically important for production than the traditional, manual act. The production, selling and buying of signs is economically more important than the 'unproductive' reproduction of the past. The Humanities are downsized unless they can make their knowledge saleable in free competition. Language in education acquires all kinds of tasks. The didaktik is sent in all directions to find order or sense in the blurred mess. Some approaches decide to stay in the middle of these confusing streams and shifts without taking a 'clear' standpoint. The discipline accepts paradoxes. We are in postmodernism.

Thus stability and change in meaning systems is a major factor for practical positioning within educational systems. By and large education and didaktik are modernistic projects, in the sense that change is not only seen as possible, but even valuable. However the disciplines have different positions in this aim. Science in school has, ironically, focused on nature as given and therefore

focused on knowledge as reproduction. The irony is that in society science, linked with technology, is given a key role in the development of both the industrial and the postindustrial society. This science cannot (afford to) be poststructural. It is bought and paid to bring about change. It cannot see itself as ambiguous. Critical fagdidaktikk (which is the important subtitle in Sjøberg 1998) is in an exposed position vis-à-vis a modernistic science.

MTE, on the other hand, has in the last century been split between given and new, tradition and innovation, stability and change. The national language is seen both as a stable system that should be nurtured and kept alive and as something that obviously changes over time, and therefore should be 'helped' in the 'right' direction. Literature consist of a canon of solid texts that survives the shifts of generations, and helps us in defining ourselves as 'German', 'English' or 'Norwegian'. At the same time MTE welcomes and allows for new writers, subjective reading, forgotten literature. Literature can be read for confirmation and for recognition.

The positioning of these elements in relation to the socio-economic development of society is not clear. However most national curricula try to sort this out by giving MTE certain defined tasks in the process of enculturation through the discipline, what is expected to be reproduced and what is new. Thus the discipline will generally leave the teacher with some relatively clear general expectations of what to do in the classroom, while the directions of these activities in relation to the development of the nation is not clear, even if such goals are often defined in the general curriculum. In Norway, at least, there is not a strong tradition of drawing these connections. It is left to the didaktik. Many MTE teachers could not care less about the connection. They feel they are employed as teachers of language and literature, not of socialization. They are teachers of the discipline. Others are concerned with the connection, but are more preoccupied with the students' learning, than the discipline. Hence the 'fagdidaktik' gets a minimum variant on one hand and a maximum edition on the other, between which there is and will be a constant tug of war. The national evaluation of Norwegian as a discipline in teacher education drew the overall conclusion that the discipline is split between two orientations, school and university (Hanssen *et al.* 1998).

Didaktization and triads in communication

All utterances (within a discipline) can be seen having basically three aspects: form, content and use, or put another way: structure, reference and action. Following Bühler (1934), Bakhtin (1986), Habermas (1990, and Halliday (1994) communication, and accordingly all utterances, texts, discourses and genres will consist of a dynamic relationship of these three aspects. They motivate and give sense to other triads in cultural theory such as symptom, symbol and signal (Bühler 1934) or heart, head and hand or identity, idea and interaction. I want to relate these three aspects in three internally, mutually defined, aspects of any discipline, namely (respectively) *aesthetics*, *epistemology* and *ethics*, which correspond to Habermas' categories of inner nature, outer nature and society (Habermas 1990) (or self, world and society in my preferred terms (Ongstad 1999a, 1999b).

Partly in line with Habermas, the considerations and evaluations of aspects of symptom, form, structures, heart, or identity (in short, the appearance of the inner nature) will be an aesthetic question, asking the nice-ugly question. In parallel the evaluation of the aspect of symbol, references, content, head, or idea (in short the signification of the outer world) will be a question of epistemology, asking the true-false question. And finally the evaluation of the aspect of signal, use, action, hand or interaction (in short the question of the embodiment of society as signified) will be a question of ethics, asking the wrong-right question. Thus these three questions or ongoing evaluations will form the possibilities and the restrictions for the different kinds of validity in question. However, the main point is that these three aspects can *never* be separated, since they are shiftingly, dynamically and mutally at work in all utterances and all disciplines (Ongstad 1996, Ongstad in press).

Consequently, to force a discipline just to deal with its own restricted epistemology, its disciplinary reference to the world, will obstruct the possibility of didaktization, that is, not to problematize the internal relationship between the aesthetics, the epistomology and the ethics. In other words, to define a language or any other 'discipline' as its segregated 'epistemology', is to cut off the discipline from its didaktik. Understanding didaktization, or didaktik, as something that stems solely from a discipline's educational use, understood and transmitted through pedagogy alone, will probably miss a crucial point – that no knowledge should be separated from its aesthetics and ethics. Triadic communicational theory (Bühler and Habermas) and triadic social semiotics (Bakhtin and Halliday) can help in addressing these questions in a systemic and a non-categorial way (Ongstad 1999c). It is not a coincidence that two new books in general didaktik in Norway (Hiim and Hippe 1998, and Rørvik 1998) implicitly deal with triads such as adventure, understanding and action, or emotion, knowledge and motion.

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Shifts of paradigm: A dilemma in foreign language didactics as a major component in the education of teachers

Abstract

The paper will discuss the problems created by shifts of paradigm, first in theories of language learning and theories of language, sometimes referred to as the academic 'parent' disciplines of foreign language didactics, and then in theories of foreign language teaching, most often referred to as foreign language teaching methods. The problems will be discussed from the point of view of educating teachers for a career across shifting paradigms. Above all the paper will question the prescriptive aspects of foreign language didactics in teacher education and argue for a greater share of analysis and criticism. There should also be an emphasis on providing the students with a historical perspective on foreign language teaching and with the underlying theoretical rationale for different approaches to foreign language teaching over time, including different 'versions' of foreign language school subjects. An important point is that the panacea fallacy in foreign language teaching should be avoided in teacher education. This will make students more prepared for the changes or major shifts that inevitably will come during their career as teachers.

Introduction

To a large extent the history of foreign language teaching is the history of the theories and notions at any time about *what language is* and *how languages are learned*. Such theories and notions constitute the cardinal pillars on which teaching methods in a foreign language are based. And the history of foreign language teaching has taught us that these theories and notions are continually changing. Thus over time we have had a succession of different teaching methods. In a school context we talk about swings of the pendulum and bandwagon effects. In the academic disciplines the term is 'shifts of paradigm'.

The activities, theories, concepts etc. dominant at any time in any academic discipline are often said to constitute a *paradigm*. By this is meant a frame of reference, which a community of specialists will share at any particular moment in history.

The history of foreign language teaching shows that paradigms tend to shift more or less according to predictable cycles. Each paradigm starts with a successful period where there is a high degree of consensus among the specialists. Then some begin to doubt and question the dominant concepts. As this development gains momentum, theoretical concepts as well as practical tools are rejected, and then finally a new paradigm replaces the old. A small 'revolution' or *a shift of paradigm* has taken place, and a new cycle has started.

It has been suggested that each cycle has a duration of approximately a quarter of a century. To the extent that such shifts in foreign language teaching methods influence the development in our foreign language school subjects, the practitioner in the classroom must be prepared to experience one or maybe two professional 'revolutions' or major shifts during her/his career. This may be problematic, in particular if the cyclical nature of paradigms and the theoretical bases of the changes are not properly understood. In my opinion an understanding of these phenomena is a prerequisite for the development of a sound, realistic and relaxed, but, at the same time, positive, open-minded and confident attitude to major shifts. An ideal teacher education should make students understand that a new teaching method should not be interpreted as 'gospel truth'.

In the present century there are several examples of major changes in foreign language teaching theory or method due to 'revolutions' or 'shifts of paradigm' in the academic 'parent' disciplines of the field, as dealt with above (further discussed in Simensen 1998). I will in the present chapter give a glimpse of basic ideas in two 'schools of thought' which have had a strong influence on foreign language teaching in Norway, one replacing the other and thus representative of a shift of paradigm. The influence on foreign language teaching will first be dealt with in terms of foreign language teaching methods and then in terms of suggestions or prescriptions in syllabus guidelines for the teaching of English as a foreign language in our schools. I will limit myself to shifts in relation to ideas about how languages are learned. For reasons of space I will not be able to deal with equally important shifts in relation to ideas about what language is. In the last part of the article I will discuss the problems involved in such shifts of paradigm in relation to foreign language didactics as a major component in the education of foreign language teachers.

Examples of shifts

Behaviourism and the audiolingual method of teaching

In the middle of the present century a selection of ideas from J.B. Watson's behaviourism in general psychology were taken up in relation to language learning, in particular by B.F. Skinner in his book *Verbal Behavior* from 1957. The basic idea developed is that learning is shaping behaviour and that human learning is similar to animal learning. As is known to most of us, Skinner's argument was that there is no basic difference in explaining the fact that a rat in an experimental cage can learn to handle some mechanism to receive a food pellet as a 'reward' and in explaining the fact that a human being can learn to use aspects of a language as 'operants' to satisfy her/his needs. The implications were that

- behaviour is a response to a stimulus,
- behaviour happens in causal, associative chains,
- all learning is a result of associative or habit-formation processes,
- learning is brought about by the repeated association of a stimulus with a response, and
- language behaviour is of the same kind as other forms of behaviour and therefore subject to the same laws of learning.

Skinner, together with many of his contemporaries, thus interpreted *verbal* learning as a process of habit-formation and as a result of some sort of *automatic* conditioning process: some patterns of language are reinforced because they are rewarded, some are not. Only those patterns which are reinforced by the community of language users, will persist. These are characteristics we normally associate with the *nurture* conception of learning. Its basis is mechanistic. Although Skinner had L1 (mother tongue) learning in mind in his reasoning, the ideas were gradually taken to apply to foreign language learning too by other scholars. And to make a long story short, one important result was the audiolingual method of teaching foreign languages. We recognize its behaviouristic

basis in the well-known slogans of the method, for example, *A language is a set of habits*. A characteristic of the method was the adoption of concepts such as conditioning and reinforcement: language habits had to be 'shaped' and reinforced. Thus in practice only linguistically correct student responses could be rewarded and hence reinforced. The following comparison illustrates the importance attributed to correct responses among the most convinced proponents: "Like sin, error is to be avoided and its influence overcome, but its presence is to be expected" (Moulton 1961, quoted in Rivers 1964: 5). As a consequence, the following advice was given to the practising teacher:

The principal method of avoiding error in language learning is to observe and practise the right model a sufficient number of times; the principal way of overcoming it is to shorten the time lapse between the incorrect response and the presentation once more of the correct model. (Brooks 1960: 58)

In practical teaching this meant repeating the right model a number of times and guiding the students so that they themselves preferably made *only* linguistically correct responses, no language errors. A key word was 'strict control': strictly controlled progression in teaching materials including strictly controlled exercises. And, of course, a teacher should try to ask only questions that she/he was sure the students could handle correctly.

The school subject

The most behaviouristically-oriented and audiolingually-based syllabus guidelines for English as a foreign language for our compulsory school system in Norway, primary and lower secondary, were proposed in *Forslag til normalplan for grunnskolen* in 1970. This document says explicitly that to a large extent language learning is the learning of *verbal habits*. The syllabus guidelines were not, however, accepted by the Ministry of Education and new syllabus guidelines were written and accepted in 1974 (M-74). These are also clearly behaviouristically-oriented and audiolingually-based although the strong claim about language learning as habit-formation has disappeared. However, the concept of habit is still there, as will be seen below. The 1974 guidelines explicitly refer to the audiolingual method and argue for *control* in the learning of new language structures. The guidelines maintain, for example, that speech habits are most efficiently established through the production of correct responses. The teacher is therefore, among other things, advised to direct controlled oral exercises "*in such a way that errors to the extent possible are avoided"* (p.149, my translation). This means that substitution tables and drills of various kinds constitute a major type of such exercises. However, it should be mentioned that a certain scepticism to the mechanistic basis of the audiolingual method had already found its way into the school subject. A certain caution was, for example, expressed against mechanistic drilling.

This was the dominant paradigm in foreign language teaching in my country in the 1960s and the 1970s. But behaviourism was, of course, already outdated in the 'parent' discipline. Thus, in fact, we may say that the 1974 guidelines were out of step with dominant concepts in academia. A new paradigm had in reality already replaced the old.

To the extent that the subject didactic education of foreign language teachers adhered prescriptively to audiolingualism in the 1960s and 1970s, we may assume that we currently have a lot of teachers in our schools who may have problems understanding today's dominant paradigm for the following reason: the *revolutionary* shift in thinking which took place after Skinner in the academic disciplines and after audiolingualism in a foreign language teaching context. This is what I will give an account of below.

Mentalistic and cognitive theories and communicative and meaning-oriented approaches to teaching

The currently dominant L2 (currently used about a foreign as well as a second language) learning theories may be characterized as *mentalistic* in the sense that they focus on what the learner brings to the learning task in terms of innate mental faculties, features normally associated with the term *nature*. They may also to some extent be characterized as *cognitive* in the sense that they focus on the processes of the mind, i.e. on the development and use of knowledge or cognitive structures, the continuous restructuring in learning of already existing knowledge structures, and a conception of the learner as active, constructive and purposeful in the learning process. The terminology itself signals the shift of paradigm: from *mechanistic* to *mentalistic* and from *nurture* to *nature*.

In the following a distinction will be made between two major types of L2 learning theories, i.e. learning theories that 1) postulate a *specific* language learning mechanism in the learner, 'a language acquisition device', and theories that 2) presuppose faculties of a more *general* nature. I will briefly deal with one central version of each type. The first is represented by Stephen Krashen's monitor theory based on Noam Chomsky's basic theory. The second is represented by the theory 'L2 learning as meaningful learning', based on David Ausubel's cognitive theory from general educational psychology.

The monitor theory based on the idea of a specific language learning mechanism

A landmark in contemporary thinking about language learning was Chomsky's criticism and rejection of Skinner's behaviouristic conception of language learning, some forty years ago (Chomsky 1959). According to Chomsky, who was concerned with L1 learning, normal linguistic behaviour is stimulus-free and innovative. He claimed that the stimulus-response and conditioning theory of the behaviourists could not explain the creativity involved in generating all kinds of *new* utterances, i.e. utterances the child has never heard before and consequently cannot 'imitate'. On the contrary, according to Chomsky, speakers produce an infinite number of new utterances on the basis of a finite number of grammatical *rules* which have been abstracted on the basis of concrete utterances which they have been exposed to. Chomsky's fundamental hypothesis was that human beings are born with an innate language learning ability, 'a language acquisition device' (LAD), later to be called 'a universal grammar'. This device develops through *exposure* to language. Although originally developed for L1 learning, the notion was applied in theories of L2 learning too, as will be shown in the characterization which follows of the monitor theory, probably the most well known of several L2 theory versions within the present paradigm.

The monitor theory is the American linguist Stephen Krashen's theory of L2 acquisition. Since it was launched about 20 years ago, it has been promoted as "an empirically grounded theory" that is supported by "a large number of scientific studies in a wide variety of language acquisition and learning contexts" (Krashen and Terrell 1983:1). The empirical basis referred to is first and foremost studies of how L2 is learned, or in Krashen's terms 'acquired', in *nonformal* settings, i.e. as a second, not foreign, language. However, the corresponding teaching theory, the natural approach, is promoted as a theory of foreign as well as second language teaching. The studies of a fixed order in the learning of some central morphemes are, for example, a crucial empirical basis for the theory. The present progressive '-ing' in English (as in 'boy running') was, for example, found to be acquired before the regular past 'ed' (as in 'she climbed'; see 'the natural order hypothesis' below).

The principal tenets of the theory are formulated as five hypotheses (see Krashen 1982). For reasons of space, I include only two of them here. These are 'the input hypothesis' and 'the affective filter hypothesis'.

The input hypothesis may be characterized in terms of four points.

a. It relates only to acquisition (by which is meant subconscious learning, such as mother tongue learning) .
b. It claims that the learner/acquirer acquires new or more language only by being exposed to *comprehensible input*, which means language that is a little above that which the learner/acquirer is capable of using himself (*i*). This is expressed in the formula: $i + 1$. The basic idea is that acquirers need to understand *meaning* first. Then, as a result, they acquire new language.
c. It maintains that if there is enough comprehensible input, the $i + 1$ will be acquired automatically.
d. It claims that speaking fluency cannot be taught directly. Rather, it *emerges* over time given exposure at the right level and in sufficient quantities. The same applies to accuracy. Finally, the input hypothesis maintains that input becomes comprehensible to the learner/acquirer through extralinguistic information and the knowledge of the world that the learner/acquirer has beforehand.

The affective filter hypothesis maintains that the learner's/acquirer's emotional state functions as an adjustable filter which passes by or blocks input which is necessary for acquisition. Thus comprehensible input can have an effect on acquisition *only* when affective conditions are favourable. This is the case when, among other things, the acquirer is motivated, has self-confidence and a good self-image. Then the learner's/acquirer's anxiety level is low and her/his affective filter is down. In the opposite case the learner's/acquirer's anxiety level is high, and her/his affective filter is correspondingly up. It is also maintained that for the affective filter to be completely down, the learner's/acquirer's focus must be totally off the language and on the content. In addition, learners/acquirers should not be required to talk until they are mentally ready for it.

The monitor theory has had a tremendous influence on L2 teaching worldwide. This does not only apply to the campaign in the 1980s against all types of grammar *teaching*, but also to the emphasis in general on a lot of comprehensible input in teaching and on favourable affective conditions in the classroom. But although many teaching theorists as well as classroom practitioners all over the world have been positively inspired by Krashen's theory, some have also strongly opposed it. Many have, for example, opposed the claim that accuracy will develop over time, and that error correction, as practised in formal teaching, is of *no* value for the development of accuracy.

L2 learning as meaningful learning

As noted above, this theory is based on David Ausubel's cognitive theory from general educational psychology (Ausubel *et al.* 1968/78).

To qualify as meaningful two conditions in learning must be met. Learning must:

1. involve *active* mental processes, and
2. be *relatable* to the learner's existing knowledge or cognitive structures.

The function of 'active mental processes' is to organize the new material in meaningful chunks, in a manner which improves the way in which such chunks are *subsumed* or integrated into the learner's existing cognitive structures. This means that existing cognitive structures are continually being

restructured. Learning is meaningful when learners are involved in such active mental processes. 'To be relatable to the learner's existing knowledge' should in relation to L2 learning primarily be understood as not being too far above the existing language level of the learner. It may be interpreted as something in the order of the '*i* + 1' in Krashen's theory.

The two teaching methods most commonly associated with the two versions of the mentalistic and cognitive learning theory type dealt with above are communicative language teaching and the natural approach. Among other things, the importance of meaningful material/input is emphasized in both. In addition, a lenient attitude to language errors in the students' language is expressed, especially in the latter. The basic assumption seems to be that errors eventually develop into correct language forms, provided there is exposure to enough comprehensible, interesting, and meaningful material.

The school subject

The next two syllabus guidelines in the row, the 1985 and the 1997 syllabus guidelines, give clear signals about the new theoretical ideas in relation to learning (M-87 1987 and L-97 1996). I will restrict my exposition here to a few examples only of this.

The first example relates to the importance for learning of exposure and comprehensible input. In the 1987 syllabus guidelines it was, for example, maintained that "learning can partly take place by means of intentional systematic practice and partly by means of varied and *meaningful input*" (p.205; my translation and italics), the latter in correspondence with Chomsky's concept of *exposure*, as described above, as well as with Krashen's concept of *comprehensible input*, as also described above. But, as we can see from the quote, the authors balance this new idea against the long-standing idea of systematic practice in the language.

The role of exposure and input in learning is emphasized even more in the currently valid currriculum guidelines, the 1997 document. In particular this applies to the reading of longer texts such as short stories and novels.

The second example relates to new conceptions about how to deal with language errors. In the 1987 syllabus guidelines teachers were advised to help their students develop a constructive attitude to language errors, such as to be able to learn from them. In the 1997 guidelines the conception expressed is that "Errors may often be interpreted as evidence of the learning process" (p.224; my translation). This reflects at least some influence from the strong claim made by Krashen and other theorists belonging to the same school of thought: that accuracy will emerge over time provided exposure is at the right level and in sufficient quantities, as referred to above.

Finally, it should be added that meaning in general became a key word in the 1987 syllabus guidelines and onwards for all levels. This accords well with cognitive theories in general, including an important point in Ausubel's theory, as dealt with above. Besides, the 1997 syllabus guidelines emphasize a conception of the learner as investigating, exploring, active, experimenting and systematic in her/his learning (repeated for all levels in this school system). This fits in well with the basic conception of active mental processes as a condition for learning in Ausubel's theory and with the equally basic constructive and reconstructive conception of learning in cognitive theories in general.

One example only out of many equally relevant

In the paragraphs above I have briefly described important shifts of paradigm in relation to theories of L2 learning, from behaviourism to mentalism and cognitivism. I have related these shifts to shifts in theories of foreign language teaching/foreign language teaching methods and to important changes in syllabus guidelines for the teaching of English as a foreign language in Norway since

1970. Among the key words discussed in the first paradigm were habit-formation, reinforcement, reward, control and avoidance of language errors, in the second paradigm a conception of the learner as investigating, exploring and experimenting in her/his learning/active mental processes, a language acquisition device, exposure to meaningful material, a lot of comprehensible input, language errors as evidence of the learning process and the automatic development of errors into correct language forms without 'interference' from the teacher. The key words clearly represent opposing trends and the crucial question is: how does the teacher cope with such revolutionary shifts? My answer is that this depends to a large extent on the type of initial teacher education he/she has got. This is what I will now discuss.

Conclusion: Shifts of paradigm in foreign language didactics as part of teacher education

From our reading of the literature on foreign language teaching methodology we know that each newly postulated teaching theory or method tends to be regarded as a panacea to cure the shortcomings of previous methods, known as the panacea fallacy in foreign language teaching. My question is: to what extent does the panacea fallacy also apply to subject didactics as part of teacher education?

To what extent are we as teacher educators, for example, tempted to prescribe a teaching method according to the method that is 'in'? To what extent do we, in other words, adjust our teaching to what is 'politically correct' or even argue uncritically for the dominant paradigm? How much critical analysis of the dominant teaching method is there, for example, in our courses? Such questions must be asked, because the crucial point is: how well do we prepare our students for the future, *for the paradigms to come?*

Many of us have been involved in in-service training. In many cases we have noticed how disappointed some of the participants have been with the promises of *the* teaching method they were exposed to in their initial teacher education.

I believe these teachers have got the wrong kind of teacher education. They are the subjects of a panacea-type of subject didactics: They have been given the 'right' answer. And I dare say it must be a hard blow to be told this was completely wrong when a new bandwagon comes around in teaching journals and in-service courses. If we provide our future teachers with only *one* way of seeing things, we clearly do them an injustice. They will be unprepared for change. And they will not have the right understanding of, and attitude to, theory.

An important function in teacher education is clearly to explain new theories, concepts, ideas and teaching methods. But theories in teacher education should not primarily be for prescriptive purposes. They should rather be for descriptive and consciousness-raising purposes and we may even say classificatory purposes. As we all know, categories normally help us 'see' better. As an example we may take Krashen's category of 'the affective filter hypothesis'. A good historical perspective on theories would contribute to vaccinating our students against believing that the new ideas etc. will solve all our problems. We must, in other words, make sure that the theories we deal with are never believed to be the whole truth.

Subject didactics is often defined as consisting of the answers to the questions 'what', 'how' and 'why'. Among such questions are "What should the objectives of a course in a foreign language be?" and "How should the content be dealt with?" Such questions are only justifiable in teacher education if followed by 'why-questions', such as "Why these objectives?" and "Why this way of dealing with the content?" because the answers are always dependent on the situation/context.

Among other things, this applies to the theoretical climate at the time of speaking. We have seen examples of this in this chapter in relation to theories about foreign language learning. Why-questions imply that the theoretical rationale must be explained.

I think it is important to distinguish clearly between the two chief roles that we are in as researchers working in a teacher education department at a university. The first is that as university employees, we are in a role where it is totally legitimate to stretch our theories to their limits, because this will only challenge our colleagues and make our theories vulnerable to disproof. This is, as we all know, an important element in how theories, concepts and ideas develop in academia. But this is not legitimate in our role as teacher educators. Neither students nor schoolteachers have the time *themselves* to read critically the basic research literature. Thus the chance that the researcher's theory is accepted is great. This places a heavy responsibility on the researcher. And this is where our second role is relevant. In teacher education we should primarily cultivate some of the other intellectual virtues, we may perhaps say obligations, of employees in a university institution: a distrust of dogmatism and a healthy scepticism to accepted truths at any time.

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Models and structures in social science and civics teaching

Abstract

In a current research project, the use of models in civics teaching is subject to scrutiny at a theoretical as well as an empirical level. The nature of various models (i.e. pictorial, symbolic and analogical) is described. A set of empirical studies, conducted by student teachers, is summarised. The results are mostly encouraging with regard to the effects on the students in compulsory as well as secondary school. In a concluding section, different teaching strategies (i.e. a transmission and a progressive strategy) are analysed in terms of a number of dimensions e.g. induction/deduction, abstract/concrete, theoretical/applied.

Purpose of the study

In Sweden, as in other countries, there is a troublesome shortage of literature on learning and instruction in civics. There are several possible reasons for this state of affairs such as the fact that the core of concepts is comparatively large, diffuse and unstable and that civics generally lacks skill development.

The purpose of this paper is to present and, primarily on a theoretical level, scrutinise strategies in teaching with a starting point in a current research project on instructional models in civics and their application in teacher training with special regard to the upper parts of the compulsory and secondary school (Vernersson 1995).

The nature of models is that they can provide simplified and formalised pictures of reality. Within the disciplinary context, models usually function as generative links between empirical studies and prevailing theory. In a didactic context, the function is a more pragmatic one – to assist the teacher in teaching situations.

Models in teaching can give hints concerning the important issues of selection and communication of the subject matter. The concept of a model has a central position in this work. The empirical parts consist of the experimental activities of 34 student teachers. The students' projects provided useful experience and deepened empirical knowledge. In the concluding section, two main strategies for the use of models – the deductive and the inductive – are discussed.

The concept of instructional science

Expressed somewhat simply, instruction comprises a what-question (the selection problem) and a how-question (the communication problem, Grue-Sörensen 1976). The issues, theories and methods stem from the subject matter, education and teaching methods. Its aim is to shed light on the teaching situation and its conditions, content, process and outcomes (Dahlgren and Säljö 1985).

Research on instruction demands – like any other field – functional instruments of analysis, e.g. an adequate terminology, concepts, models and theories. A firm theoretical basis should, thus, be established by existing and new elements. In a more long-term perspective, integrated subject matter and didactical schemes of analysis should be developed and tested in realistic teaching settings.

Every teacher has to arrive at – within the framework of existing curricula – good answers to the central questions of why to teach a certain content (the question of legitimacy) as well as the above-mentioned selection and communication questions.

The teaching process is further influenced by prevailing conceptions of the surrounding world and of science as well as civics and educational psychology.

Teaching and learning

Learning is the process whereby our conceptions of phenomena in the surrounding world emerge and/or undergo changes. A central point of departure for our work is a qualitative conception of knowledge.

Cognitive development is, according to this perspective, not primarily a quantitative growth of knowledge but rather qualitative changes in our conceptions of the world (Marton *et al.* 1997). For the students, the question is to find fruitful ways of organising a seemingly ambiguous, unrelated or chaotic content into continuous strings of meaning. Starting from their preknowledge and preconceptions, and with the help of reflected strategies, they face the task of solving the objectives they are presented with. The most interesting differences in learning are not made up of quantitative differences in outcome, but rather how deeper aspects of the learning task are conceptualised. Empirical studies of meaningful learning have shown that the approach to learning can be either deep – or surface-oriented. A surface approach is characterised by a focus on the text itself. Such an approach is also accompanied by a concentration on details and limited parts of the text, which has been denoted an atomistic organisation of the learning task (c.f. Marton *et al*. 1997; Svensson 1976). A deep approach, on the other hand, is an endeavour to, via the text, arrive at the message of the discourse. This approach also means an organisation of the text into larger entities, i.e. a holistic organisation. The deep-surface dimension is referred to as the referential aspect of meaningful learning, whereas the atomistic-holistic dimension represents the organisational (Marton *et al.* 1997).

Through phenomenographic studies, i.e. deep interview investigations aimed at describing people's conceptions of various phenomena – or, in the jargon of the latest texts, ways of experiencing a phenomenon (cf. Marton and Booth 1997), we can achieve an understanding of the students' preknowledge and conceptions of the surrounding world. Knowledge of this kind constitutes an essential part of teachers' professional competence. It is a common experience among teachers that what is taught is not necessarily identical to that which is learned. Thus, we have to consider an internal perspective comprising the students' learning, and an external perspective regarding the teaching, i.e. the professional task of selecting, organising and communicating the subject matter.

A more thorough understanding of the two perspectives can bring about interesting hypotheses and, in a more long-term perspective, conclusions about the nature of the dependence between the two. In the future, interdisciplinary investigations about the relations between instructional methods and the subject matter will in all likelihood be among the most important kind of research for the education system.

Society as a field of knowledge

The social sciences differ in certain fundamental respects from the sciences. The former have developed from the philosophy of society. Several social scholars have contributed to what we today denote as the social sciences (Kaysen 1973). The philosophy of society has in the past been characterised by speculative and normative statements. Empirical research has, in a historical perspective, played a minor role. To a large extent, the early empirical researchers collected data in a non-theoretical way lacking theory and a priori assumptions (Inkeles 1966). A fruitful interplay between theory and empirical data thus did not emerge. In modern social science, on the other hand, the fundamental epistemological questions play an important role. It is of great importance that these kinds of questions are considered in teacher training as well as in the schools. Comparisons with the sciences can provide evidence of the relative nature of knowledge. The perspective presented here departs from the basic assumption that reality can be shared not only in a physical but also in a social dimension (Rosengren and Arvidsson 1986).The technological and scientific progress made during the 17th and 18th centuries had a great impact on our thinking about man and society.

Man had discovered the universal laws of motion. Everything could be predicted. The universe was a clock work, once started by some creator but now tick-tacking on its own with predictable precision. (Pettersson 1987, p.13)

Modern physics has contributed with complementary and new perspectives on classical Newtonian mechanics. Conceptions about the absolute nature of space and time have been revised through the development of the theory of relativity, quantum mechanics and thermodynamics. Concepts that are in themselves expressions of uncertainty, e.g. non-linearity, instability, uncertain relationships, irreversible processes, entropy and non-equilibrium have been developed. According to Popper (1979), reality can be illustrated by a pair of concepts. Let us imagine that different phenomena can be placed along a dimension.

*The extremes on this scale are the cloud and the clock. The cloud represents phenomena such as gases, unordered, irregular and more or less unpredictable. The clock is a symbol of the opposite; order, regularity and predictability. (*Ibid. p.21)

Giddens (1984), one of the major sociological theorists of our time, claims that we cannot conceive of society or social phenomena in the same way as phenomena in nature. Societies only exist to the extent that they are created or reshaped by human actions.

If we accepted the cloud as a model for the social sciences, this should mean that the only law is that of chance. Any systematic, general knowledge about society would be impossible. Social scientists would be forced to abandon their present nomothetic ambitions, i.e. attempts to formulate theories and laws, in favour of descriptions of isolated phenomena and events. But we also realise that the clockwork is no longer sufficient even as an ideal for modern science. The next question is therefore: is there any third alternative between the deterministic clockwork and the probabilistic cloud?

The task is to find a science that can combine freedom and order, that accepts in determinism but considers the planned actions of man. (Pettersson 1987, p.24)

Deterministic systems may be more or less deterministic. Lack of order does not necessarily mean total lack of predictability. Social actions do not occur in a vacuum but within a framework of external and internal boundaries and possibilities. Social scientists have the task of systematising, analysing and finding general patterns in this interplay between freedom and order, between actions

and existing institutions. Hägerstrand (1982), has developed and illuminated what he holds to be a deep conflict between two fundamental principles of order, the principles of closeness and similarity.

By taking his point of departure in Vidal de la Blances concept "genre de vie", i.e. life style, he points to the symbiosis between nature and society in the traditional society.

People lived within a common body of knowledge, comprising topography and population, natural resources and available technology for producing necessary commodities. What happened reminded one of a text where individual activities corresponded to the words which, put after one another, established sentences. (Ibid., p.173)

What happened, Hägerstrand claims, was evident even if the possibilities of varying the content were delimited. The industrial revolution has brought with it a dominance of technological rationality in modern life. The comprehensible society of closeness has gradually been replaced by a modern incomprehensible society of consumption and production based on the principle of similarity. This means that artefacts and activities which are similar or demand the same kind of knowledge, are produced or categorized together regardless of position in space and time (*ibid.* p.175).

This is, Hägerstrand writes, basically an intellectual construction, which is exchangeable with other ways of creating order when technology reshaped the old society (*ibid*. p.175).

What happens here reminds one less and less of the words in a text and more and more of words in a dictionary,

What stands on a page is determined by formal similarities (the same initial letter) but does not constitute a text with an obvious meaning. To form a text, words must be picked from many different places. The meaning of society has thus become more and more diffuse. The fine tuned complex has been replaced by something untuned and entangled (*ibid.* p.174).

A critical reflection on the principles above can help us achieve a better understanding of the interaction between the fundamental factors that influence the development of society and, furthermore, provide precise starting points for subject-matter specific instructional strategies for structuring and analysing.

Max Weber tried to bridge the gap between nomothetic and ideographic science by introducing the concept of 'ideal type'. The purpose was not to state a goal, but to provide a fruitful tool for research. The ideal type is a vision unifying some of the relations and events in life into a homogeneous universe, a hypothetical whole. It is, in other words, a logical idea which may not be mixed up with reality. The ideal type has its own abstract, theoretical existence without any real content. It is thus not a hypothesis that can be verified or falsified. It is, furthermore, not a common description, even if it has unambiguous, idealised expressions. Ideal types are, of course, constructed by utilising the available preknowledge about societal phenomena (Pettersson 1987). The usage of ideal types has an instrumental purpose. From an instructional perspective, ideal types are of significant interest. It may appear that these, in teaching contexts, are even more useful than current models. The classical model of free competition in economics rests on assumptions about rational and fully informed actors. This model has come to be one of the most well known but also questioned examples of an ideal type. Another interesting example is Ross' (1963) analysis of democracy by means of ideal types and real types. His systematic and profound thinking about the prerequisites, meaning and problems of democracy still deserves great interest as a theoretical foundation of current 'civic upbringing' within civics.

Civics as a school subject in Sweden is a so-called composite made up of the contents of several academic disciplines (LPO 94 1994). As regards upper secondary school, the main constituents of the subject come from political science, economics and sociology. The basic education of the student teachers in the subject is given in the form of integrated courses.

Models

Our purpose in the following is to deal with the issue of different models in civics and their usage in teacher training and school teaching. Models are more or less simplified pictures of reality. They are regarded as tools of thinking when understanding the interplay between theory and data. A theory may be defined as a number of mutually connected, systematically ordered statements about reality, that point to regularities, relations, causality and that are entirely or partially testable (Lindblad 1981 p.37).

Expressed in a somewhat simplified way, a theory is a logically connected system of statements expressing relations between carefully defined concepts (Rosengren and Arvidsson 1986, p.24).

Research means a constant search for commonalities, regularities or patterns concerning properties of the different phenomena in reality. Reality consists of different phenomena, language consists of terms. Concepts relate to phenomena possessing some kind of similarities. In other words, they can be regarded as determinations or classes of determinations delimiting a class of entities (Marc-Wogau 1961). A conceptual structure is obtained by a collection of fairly well-defined concepts with explained relations. Highly defined concepts and relations are referred to as schemes of analysis or, sometimes, paradigms. Sets of well-defined concepts and relations are often referred to as models. A model is often conceived of as a simplified theory. For this reason, it is sometimes difficult to distinguish models from theories.

The simplified presentation above gives us a sequence of development from phenomena in reality, via terms and concepts, to models and theories. The borderlines between the various steps are obviously diffuse. The interplay between model – theory – reality is usually set in a context comprising choice of perspective and formulation of problems.

Some common categories of models

Below, an attempt will be made to present some different kinds of models often used by social scientists.

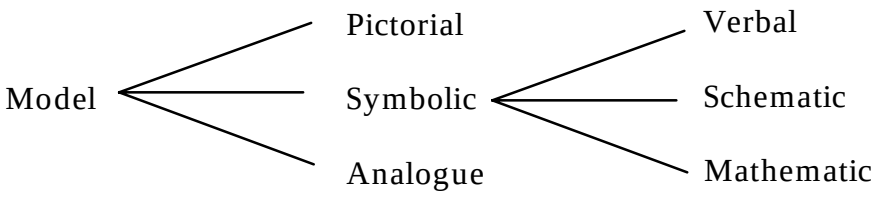

Figure 1 Models according to model technique (Hägg and Wiedersheim-Paul 1985)

Pictorial models – sometimes denoted iconic or scale models – represent visually certain aspects of a phenomenon. Examples are photographs, drawings and maps. Analogical models are used when we are interested in analogue, i.e. corresponding similar, or parallel, performances or behaviour. Some philosophers have thus pointed to structural similarities between the societal body and biological systems.

Symbol models, finally, are very frequent in social sciences. They are formulated by using different symbols (letters, words, integers, mathematical and logical signs, arrows, boxes, diagrams, etc.) representing reality. Here, they are distinguished as verbal, schematic and mathematical models. Verbal models are, in principle, composed of words. The language of politics is rich in metaphors, i.e. expressions used in a transferred meaning. Politics is sometimes regarded as navigation. The skipper stands at the helm of the state, determines the course, is wrecked, hits a rock, lays a hull and brings the ship into port. When road traffic is the metaphor, the politician is at the steering wheel, steers, uses the brakes, stands at a cross-roads and collides. Sometimes, politics is turned into objects such as pyramids, machines and webs. In the meteorology of politics there are winds, waves, gales, clouds, thermometers and prognoses (Pettersson 1987).

Schematic models symbolise factors under scrutiny and relations between these by means of different figures. Matrices, pyramids, circles and squares are common components of such models. Arrows between boxes are used to describe relations and dependencies. They may be single or double sided. Causal relations may be more or less complex. Quantitative data may be illustrated by tables, coordinate grids or diagrams. In mathematical models, graphs, equations, functions and formulae are used. Models may also be combinations of mathematical, verbal and symbolic illustrations.

Models may be descriptive and/or explanatory, static or dynamic, open or closed in relation to the context. They may furthermore be qualitative or quantitative, deterministic or non-deterministic.[1] From economics we are familiar with micro and macro models.

Efficient models are rare and cannot be derived from reality by any automatic process. They are not reality as such. The critical points in the contact between reality and model may lead to new models. When reality is difficult to study, it is often the existing model that nourishes the intuition demanded when constructing a new one (Rosengren and Arvidsson 1986, p.23).

Paul Samuelson, the well known economist, has emphasised the necessity of abstracting from an unlimited mass of details. “No brain can grasp a mass of unrelated facts. Analysis means abstracting. It is necessary to idealize, to omit details, to formulate simple hypotheses and patterns, through which facts can be put together, to formulate the adequate questions, before we observe the world as it appears” (Samuelson 1969, p.19).

The density of facts in education and teaching often leads to a surface approach to learning. In a kind of benevolent attempt to convey to the students as much as possible, teachers sometimes ride roughshod over their students. Hence, we have to arrive at a consensus about what it is really important to communicate. Primarily, teaching should be centred around a core of important content. Fundamental concepts and principles give meaning to derived parts of the subject matter.

Hereby the student can economize by learning these fundamental concepts since insight into them permits the student to reconstruct that knowledge, which is essentially derivative of more basic regularities (Marton *et al.* 1977, p.136).

We would like to regard the present work on model usage from this perspective. As overarching models are often missing within the social sciences, it is a challenging task to make an attempt to provide useful didactic models. Models with the power to cover phenomena within political science, economics, sociology and ethnogeography will, in all likelihood, be very abstract. It has sometimes been claimed that an increasing level of abstraction inescapably leads to a decrease in meaningfulness. Such a view is not always correct.

Abstractions sometimes summarize basic conceptual problems and relations that are, from a research perspective, precursors of empirical content. Above all, it is sometimes necessary to raise the level of abstraction in order to provide substance and meaning to a set of elements or variables that at a first glance do not appear to be related to each other in a meaningful way, when examined at lower levels of abstraction (Young 1968, p.41. See also Easton 1965, p.25).

If we can clarify and understand the overriding principles of a system we also have the capacity to understand why the constituents of the totality function as they do together (von Wright 1987).

In an earlier work (Vernersson, 1989), we presented a great number (about 50) of models for use in teacher training and teaching in the schools. The models were categorised into three groups:

1. Composite or superdisciplinary models. These models illustrate the interplay between nature and society and may be applied e.g. when discussing environmental care and issues about global survival. Superdisciplinary models are dealt with in content composites, i.e. science or social science.

2. Flowcharts for system analysis with adequate examples. Besides traditional disciplinary perspectives, we have – based on a system's theoretical and functionalistic perspective – attempted to structure and systematise central parts of, above all, the political science part of civics.

3. Superdisciplinary and disciplinary models. These models pertain to concepts and relations within and between relevant disciplines. Disciplinary models are relatively frequent. They appear in most textbooks. Teachers attempt – sometimes together with the students – to construct models of their own.

An empirical study of model usage in civics teaching

During their teacher training, 34 student teachers carried out studies of models in teaching (23 males and 11 females). The purpose of the studies was to:

1. Give the students an opportunity to study and work with models during their 10-week practice period.

2. Obtain an empirical body of material containing useful examples for teaching as well as for didactic research.

Below, some examples from the students' investigations will be given. The selection has been made primarily to show the variety of models developed by the students. The students in general succeeded, despite the relatively limited time to hand, in solving their tasks in a satisfactory way. One group of students used a so-called meta model, with which they intended to develop their pupils' thinking about causal relationships. The model was applied in upper secondary school teaching to a section on the localisation of a steelworks in the U.S., by applying Montesquieu's balance of power and studying China's development into a republic. In these two cases, the model was applied in lower secondary school teaching. The evaluation of the effects is, in all cases, very encouraging. Positive effects have been documented in the evaluation as regards (a) understanding causality and (b) resulted in the eventual superior performance of a class where the initial performance was inferior to that of a comparison class

Another model, which is basically a model of causality, applied in an analysis of the French revolution, was used in lower secondary school. The experiment proved to work very well. The introduction of the model affected the pupils' understanding of historical events as well as their knowledge about significant details.

The disadvantages in this case are primarily (a) the increase in time required, (b) the sometimes monotonous character of the teaching and (c) the somewhat simplified picture of a complex reality.

An additional model has been used in upper secondary school to clarify the basic structure of the Swedish constitution in comparison with three other western democracies. The use of this model resulted in a better comprehension of constitutions in general and also an improved retention of facts compared with the comparison group. The "model group" also improved its ability to search for and explain causal relations and to establish a personal view compared with the pupils in the comparison group.

Another model illustrated six different levels of activities with regard to work in the area of environmental care. This is a kind of participatory model, aiming at increasing the self-awareness of students in upper secondary school and to influence their attitudes towards a significant global issue. The participatory model enabled the students to understand complex relations.

A further model was used to illuminate the global distribution of resources for students in lower secondary school. The classroom application of the model showed that, although the students were able to recall the model, they appeared to have merely memorised it, without having understood the deeper purpose underlying it.

Finally, a pictorial model was developed to illustrate the Jewish religion to students in grade 7. The model called 'David's star' was a very successful tool in the learning process. The three basic elements of the model 'The history of the people', 'The Confederation' and the 'Confession', constitute the basis of the other parts 'The Feasts' 'The Nation' and 'The Sabbath', representing the religious manifestations. These are unique to Judaism, while other characteristics could constitute a point of departure or a systematic comparison with other confessions. On this level, the model thus possesses a certain degree of generality.

Together, the students' investigations have provided valuable experience of the merits and shortcomings of different models. The results of these studies and other experience (cf. Lompscher 1987), indicate that models, if correctly designed and used, may be powerful tools for developing the students' comprehension. Because of the relatively small sizes of the experimental groups, the shortage of time and the provisional methods of evaluation, we must be cautious when interpreting the results. The studies do, however, point to fruitful starting points for further empirical research.

Strategies in model application

The aim in the following is, in the light of perspectives and results hitherto presented, to discuss the value of two different main strategies for the use of models in teaching. The essence of meaningful learning is, as mentioned above, the emergence of a qualitative change in conceptualising a phenomenon. The conditions under which such a change occurs is an intricate question

It seems, however, to be an indispensable demand that the teaching should bring about some kind of conflict in the mind of the learner, in order to generate a need for a change (Dahlgren and Vernersson, 1987 p.71).

Models do, in different ways, articulate concepts, events and relations. They can be placed along a continuum from more to less direct pictures of reality to symbols for the constituents of the models (pictorial analogies).

Earlier, we have tried to exemplify how models may be used for the formulation of problems and choice of perspective. A certain model may generate a great number of questions and hypotheses. When existing knowledge can be integrated into an already established model we may regard this as assimilation in the Piagetian vocabulary. If a model has to be replaced by a new one we are dealing with accommodation. According to the recent curriculum for the compulsory school – as well as in the new syllabus for the secondary school – observations, theory and applications should occur in a circular process with scientific research as a template.

Simultaneously, the teachers' 'external' professional task, to select, structure and communicate the content should be considered, as well as the students' 'internal' reflection and individually coloured synthesis of the syllabus. Thus the learning process contains an important participatory, i.e. democratic, dimension. The influence from teachers and students primarily concerns choice of perspective, formulation of problems, choice of methods, and evaluation.

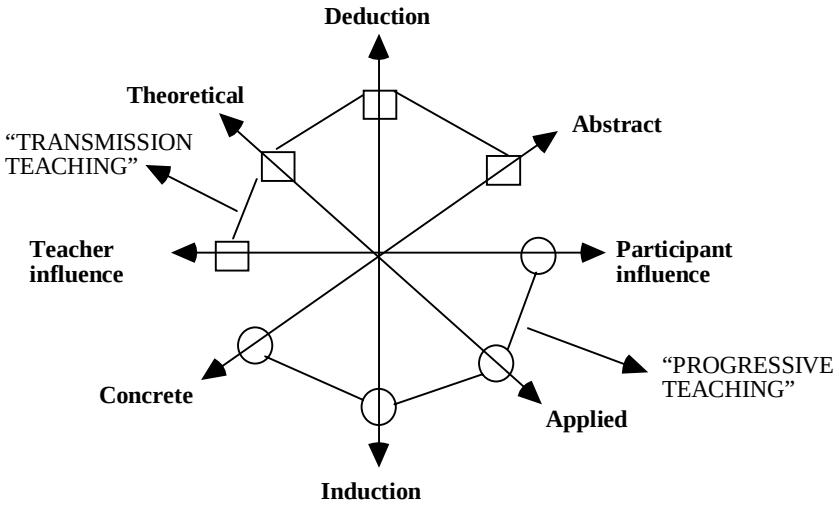

Figure 2 The basic dimensions of teaching strategies

Figure 2 indicates that the influence of the actors may be distributed along an ordinal scale from a dominance of the teacher to a dominance of the students. Other dimensions include deduction – induction, abstract – concrete and the theory – application aspects. At the intersection a kind of mutual balance exists. The proportions of e.g. theoretical and practical elements are, for example, equal.

The present curriculum for the compulsory school prescribes an emphasis on enquiry learning by applying inductive methods. These methods are quite common in the arts and social sciences. The alternative is a deductive approach, i.e. a method by which conclusions are logically dependent on the premises at hand. Assumptions made from various models or theories are tested by empirical observations. Deduction is common in mathematics and in the sciences. Abstract thinking means disregarding certain aspects of minor importance in order to be able to observe more significant similarities and differences. Concrete thinking, on the other hand, means an emphasis of the aspects that are tangible and related to everyday life. Applied thinking is developed into theoretical thinking as we introduce hierarchical concepts, models and theories. Using the schematic diagram above, we can obtain a point of departure for the scrutiny of the effects of existing strategies in teaching

and learning. Placing these in the coordinate grid gives rise to different graphic patterns, which depict different possible and actual combinations. In practice, deductive teaching strategies combined with a high degree of teacher influence are probably quite common. When this kind of teaching is characterised too much by the teacher's personality, without consideration of the students' preconceptions, it has normally been classified – and criticised – as traditional transmission teaching.

An inductive strategy, on the other hand, may very well involve a high degree of student influence and depart from the students' conceptions of the surrounding world. It may also have an applied and concrete character. Often, it leads to disciplinary borders being abandoned in favour of problem-oriented and interdisciplinary activities of a project character. Many so-called progressive approaches to teaching have their roots in this perspective. The question about the optimal proportions of deductive and inductive elements is an empirical issue that must be dealt with in subject-matter oriented instructional research.

The use of models in teaching is probably mostly deductive in the sense that established models are utilised. Ausubel (1962) has advocated that general parts should forego specific and abstract parts should precede the more concrete.

It would seem desirable to introduce the appropriate subsumers and make them part of the cognitive structure prior to the actual presentation of the learning task. The subsumers introduced would thus constitute efficiently advanced organizers or anchoring foci for the reception of new material (*ibid.* p.219).

Learning, according to Ausubel, occurs through the subsumption of new material into existing structures. This line of reasoning leads us in another direction than is normally recommended in teacher training. Ausubel proposes providing initially the more overarching models and theories rather than presenting them retroactively.

There is earlier evidence of the value of deductive strategies in teaching (Vernersson 1989). The complexity and changing nature of civics as a field of teaching in combination with the large amount of facts calls for a more common use of superdisciplinary models.

There are, however, some obvious dangers in model usage, e.g. technification (Marton 1976), that is that the students merely respond to expected demands, for example in an examination, in a mechanical way or by means of horizontalization (Wenestam 1980), and that the different status of a principle and the examples provided are levelled out. The use of models requires a kind of training of the students' skills to make them acquainted with the point of models as a learning tool. (This is an issue within the metacognitive domain, that is the field of learning to learn.)

Inductive strategies normally aim at having the students independently formulate and analyse issues in society. The goal is to arrive at personal models or 'theories' which later may be tested against reality. The strategy is well established within teacher training in Sweden. As in all methods of teaching, it does, however, have its shortcomings. Thus, it has been observed that the students' knowledge is sometimes superficial and fragmentary. The two strategies probably do not occur very often in pure, refined versions. A solution may consist of flexible and varying changes between the two. The choice of strategy is, in the final analysis, dependent on the nature of the goals. Furthermore, and perhaps of even greater significance, considerations that arise in connection with this choice reflect our conceptions about the nature of scientific research and knowledge. It may also be, and this may be an unorthodox way of reasoning, that didactical reflections lead to an enriched, enlarged and possibly changed perspective on science itself.

Note

Issing (1987) has used the following categorisation of pictures: representational (or realistic) pictures; logical (or arbitrary) pictures; pictorial analogies:

Representational pictures have a physical resemblance to the things or concepts they stand for. The degree of resemblance a picture has to its reference object is defined by the amount of realistic details

Logical or arbitrary pictures show no resemblance to the things they represent but are arbitrarily and only logically related to their referents. Logical pictures comprise diagrams, graphs, maps and other schematized charts ...

Pictorial analogies look like representational pictures – they may show quite realistic objects – but they refer to something other than the content which is openly depicted in the illustration. The pictorial analogies used are intended to help the learner to interpret new information by using prior experience or knowledge ... Quite often these pictures contain some humoristic or stimulating elements which make them quite attractive illustrations. (Ibid. p.2).

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Issues of Didactics in Teacher Education: outcomes of an interdisciplinary workshop

Abstract

In the academic years 1997/98 and 1998/99 the Institute for Research and Development in Education of the Faculty of Education of Charles University organized an Interdisciplinary Workshop of Pedagogy. The topic of disciplinary didactics (subject methodology/Fachdidaktik) in teacher education was discussed within 13 sessions with the participation of the faculties of education in the Czech Republic and other university faculties which offer teacher education programmes. This paper summarizes and comments on the outcomes of the workshop.

Keynote questions:

1. *Is disciplinary didactics (subject methodology/Fachdidaktik) regarded as a scientific field and what are the arguments?*
2. *Does the curriculum of didactics reflect the changing social and educational context?*
3. *How is didactics participating in preparing students for the teaching profession ?*
4. *What is the relationship between general and disciplinary didactics in teacher education?*
5. *What is the status of disciplinary didactics in professional and academic disciplines in teacher education?*

Introduction

With the new social and educational context of the 1990s teacher education in the Czech Republic has become one of the most common topics of expert discussions, conferences, research and development projects and school legislation. The change in the concept of the teaching profession which is connected with the general reform of educational systems should immediately influence the education of prospective teachers.

The anticipation of European educational principles plays a significant role in this field (UNESCO 1996) – lifelong learning, learning society, globalization, universalization of education and the European dimension of education – which ought to be part of teachers' professionalization process

It is possible to describe the 1990s as a period of change and transformation in education (OECD 1996) and a period open to various opinions and concepts which represent extremes and absurdities on one hand and optimal solutions on the other, whilst responding to the needs of society, educational and cultural traditions of a nation and European development.

Teacher education

Initial teacher education in the Czech Republic is being established at university level and has a double-track character. It is being practised in teacher education faculties that are part of universities and in other university faculties that also introduce teacher education programmes. Faculties of education mainly educate prospective basic school teachers (basic school equals primary and lower secondary level, obligatory school attendance) in 4 to 5 year programmes. Some faculties of education are accredited for 5-year comprehensive programmes that include the training for teaching in basic school, gymnasium and upper level secondary school (general education subjects only).

Teacher education for primary school is always an independent programme as is the independent programme for teachers in special education. Other university faculties mostly concentrate on teacher education for gymnasium and upper level secondary school. Vocational school teachers are trained at technical, economical and agricultural universities.

The integrated model is the prevailing one in initial teacher education. Prospective student teachers study academic and professional studies together and receive a master's degree for teaching. The teaching qualification can also be gained within the so-called consecutive model which means that graduates who have a master's degree (or a bachelor's degree) only study the professional programme and receive a certificate for teaching.

Kindergarten teachers gain their qualification by 4-year studies and final exams (mature exam) at the secondary schools of education or 3-year bachelor studies at faculties of education.

Teacher education is going through several stages of change in the 1990s and is affected by the following characteristics and barriers:

- plurality in teacher training conceptions and variability in the curriculum as a result of the autonomy of universities and their faculties, together with the non-existence of teacher education standards. This situation creates a lack of comparability between the graduates from various teacher programmes
- various levels of weaknesses of the professional curriculum within the teacher training programmes with respect to the scope and the presence of single pedagogical and psychological disciplines and teaching practice
- inter and intradisciplinary problems of the sciences of education which are affected by the ideology of the past.
- a certain amount of conflict between the curriculum of professional teacher training and school practice requirements arising from the diversification of the school system, alternative models of teaching, curriculum changes and school life
- decreasing interest in teacher training programmes and consequently decreasing number of graduates entering teaching as a result of worsening of working conditions
- the absence of a system for the continuing professional development of teachers
- poor linkage between the concept of initial teacher education and existing programmes of continuing professional development
- gaps in legislation referring to professional competencies of teachers and how these are evaluated.

It is obvious that there are several topics here whose analysis goes beyond the scope of this paper. We will therefore only discuss the sciences of education and their place in teacher training

Sciences of education in teacher training

From the 1950s to the 1980s pedagogy was discredited, not only as a social science based on a single Marxist world opinion, but mainly because it reproduced state ideology into child and teenage education in our country. Pedagogy was able to consider various pedagogical tendencies and western theories but always with the critical Marxist point of view that they were unacceptable and harmful. Many educators and teachers therefore declined this science.

After 1989, as a result of political and social changes, the sciences of education were immediately 'deideologized' and the disciplines which had been suppressed (comparative education, sociology of education) began to develop. Some subdisciplines disappeared and new theories appeared (philosophy of education). Interdisciplinary based areas like education policy or school management are also finding a place among other sciences of education. Unfortunately, doubt about pedagogy remains and it is in general given a normative function.

The contemporary structure of professional studies normally includes the following pedagogical disciplines: general and comparative education, history of education, sociology of education, social education, general didactics, disciplinary didactics and teaching practice. Some programmes also include optional courses oriented towards specific issues of education. The study of psychological problematics concentrates on the psychology of education and social psychology.

Didactics as a discipline of the teaching profession deserve special attention. They make a significant contribution to forming professional competencies for teaching, which is the main professional activity of a teacher at school. An integral part of the teacher training curriculum at teacher education faculties has always been general didactics and disciplinary didactics. General didactics is part of the pedagogy and psychology unit but disciplinary didactics is part of the academic studies, which also reflects the inner institutional structure-departments of teacher education faculties. The approbation/qualification for teaching in lower and upper secondary schools is a double-subject (equivalent to major and minor) which means that students "meet" didactics three times but often as completely different disciplines. For primary school teacher education is multididactical which means that this problem can become even greater.

General didactics is derived from the systematical didactics of Komensky as a general theory of teaching and learning. The roots of disciplinary didactics go back to the last century when the methodics as normative guides of how to teach various subjects were formed. As soon as teachers' studies became a part of university studies the methodics gradually began to develop as a scientific field of education. At the turn of the 1950s and 1960s disciplinary didactics were constituted as independent scientific disciplines that were acknowledged at universities by the end of the 1980s and associate professorships ("docent") and professorships were awarded in this field.

The development of disciplinary didactics concepts from the 1960s to the 1980s

Disciplinary didactics moved away from methods based on experience (Kotasek 1998) and began to be influenced by sciences of education and mainly general didactics as its manifestation for a certain subject. That means that all categories, relations, principles and concepts of general didactics were transformed into a teaching theory of single subjects. This approach is perceived as an *applied concept*.

In the 1970s another concept of disciplinary didactics appears. It is based on an interdisciplinary approach with integrated contributions from various scientific disciplines towards education and

teaching of a certain subjects. That is the so-called *integration concept***,** including a scientific discipline transformed into a subject and pedagogical, psychological and sociological approach towards the interaction between teacher/students/subject matter.

In the middle of the 1980s a *communicative concept* of disciplinary didactics was born. It describes a specific process of transformation, transmission and delivery of scientific knowledge of a certain scientific discipline through education towards individuals and society. The communicative concept respects the specifics of scientific disciplines, their content characteristics, the methodology of discovery and the options of access for everybody within different intellectual levels. Disciplinary didactics is considered as a "boundary discipline" with interdisciplinary character which has its own subject and makes use mainly of the methodology of sciences of education.

At the beginning of the 1990s the status of disciplinary didactics became questionable. It was considered to be only a partial course of the teacher training curriculum. This situation soon became unbearable according to the current requirements of the professionalization of teaching, it evoked the revival of debates and attempts to find justification for the scientific acknowledgement of disciplinary didactics.

The discussions about disciplinary didactics at different expert levels have also been fuelled by the fact that in the past readiness of graduates for the teaching profession was unsatisfactory and it was criticized.

Students and graduates of teacher training programmes are often disappointed at the beginning of their teaching career and even during their first experience with the reality of school teaching practice. It seems that prospective teachers do not have the necessary professional knowledge and skills. So the final result of their first contact in practice is usually a clash of emotions followed by disappointment or disgruntlement, for both the prospective teachers, the new graduates and their employers.

These facts are especially alarming in a situation when significant changes are happening in the education system, education policy, school legislation and school life. It seems as if the changing educational context and requirements of education were ignored by faculties and educators who ought to be educating the new generation of teachers for new educational situations and conditions. It is a challenge which should at least be considered in evaluating the effectiveness of the teacher training curriculum, especially professional studies. De-ideologization alone is not enough for the development of the sciences of education and professional curriculum.

Disciplinary didactics under scrutiny

The necessity for considering disciplinary didactics is, apart from the points made above, supported by the fact that it implies the highest level of professional training within the teacher education programme. The Interdisciplinary Workshop of Pedagogy, organized by the Faculty of Education of Charles University in Prague in the academic years 1997/98 and 1998/99 became the expert platform for discussion of didactics. The development of disciplinary didactics as a scientific discipline and part of the teacher training curriculum were discussed during 13 expert sessions of teacher educators from faculties of education and other university faculties educating teachers.
The following disciplinary didactics were introduced during the workshops: mother tongue, foreign languages, mathematics, physics, biology, chemistry, geography, civics, music, art and physical education. The aim of the meetings was to summarize the answers to given questions, to review the

current state of disciplinary didactics and its problems and to look at the perspective of further development within the academic and school context.

Another aim was the meeting of teacher educators and support of the intra and interdisciplinary communication within the institutional structure responsible for the prospective teacher training. Although the expected aims were not completely fulfilled it was possible to summarize and come to a conclusion through the key questions towards which the presentations were aimed:

1. Is disciplinary didactics (subject methodology/Fachdidaktik) regarded as a scientific field and what arguments are there to support this?
2. Does the curriculum of didactics reflect the changing social and educational context?
3. How is didactics participating in preparing students for the teaching profession ?
4. What is the relationship between general and disciplinary didactics in teacher education?
5. What is the status of disciplinary didactics between professional and academic disciplines in teacher education?

The following comment tries to show the common features of disciplinary didactics and their specifications based on the these questions.

Question 1

The starting point of the answer is the following statement by the participants*:* disciplinary didactics can be considered science only if it asks questions about changes in education and teaching of a specific subject or group of subjects with respect to the changing educational context; and if it solves and creates new discoveries. It should generalize experience as a theoretical reflection.

The core of the argument supporting the scientific status of disciplinary didactics is the limitation of the subject and research methods. In this respect disciplinary didactics were introduced in various ways. Some represented absolutely specific subjects (e.g. civics-citizenship, arts-arts cognitive transformation), others described “the activity of a teacher and a student during the subject lesson” or “the principles of education and teaching of the subject” etc. Those concentrated more on the application of general didactics than specification of a subject of these disciplines. That indicates the intent of the research projects within the disciplinary didactics presented during the workshops. Significant shifts in preference of certain aspects of teaching and education (e.g. from products to processes) are obvious.

In general it appeared that most of the educators did not consider the subject of disciplinary didactics a scientific discipline. Rather they considered it as a subject of higher education instruction of prospective teachers, although active verbs such as ‘transforms’, ‘interprets’, ‘applies’, ‘mediates’, ‘discovery’ were sometimes used.

A common view was reached. That is, that disciplinary didactics is a “boundary discipline” falling between the scientific field and general didactics. It uses a methodology of pedagogy and partly of psychology. Specific single methods of disciplinary didactics (e.g. didactics of mathematics, civics) were also suggested but remained open to discussion.

The prevailing opinion also seemed to be that disciplinary didactics is neither a normative nor a receptive discipline. It is inclined to be more constructive. The concept of the simple application of general didactics also seemed, for the majority, unsatisfactory because disciplinary didactics goes beyond the general sciences of education.

Curriculum/subject matter remains the core of disciplinary didactics. But the aspect of student personality and his/her learning process is important. Therefore, even the concept of teaching and the teaching profession gradually gains a new dimension in the teacher training curriculum.

It seems to be important to create a framework for the disciplinary didactics subject as a science which describes the common and distinguishing features of these scientific disciplines. It is impossible to accept either disparateness or simplification in support for the scientific status of disciplinary didactics.

One of the ways in which to define the subject of disciplinary didactics is the acceptance of the communicative concept . Then the subject of disciplinary didactics can be characterized as a specific form of communication between a scientific/art field and the subjects/objects of education. A teacher has a dominant role of social interaction and pedagogical communication in introducing the scientific/ art cognition within the conditions of school teaching/learning.

The scientific/art field gives certain specificity to disciplinary didactics not only by its content/ subject and methodology, but also in demonstrating the way in which it can be transformed into a subject and teaching strategy and incorporated into the process and system of education. That means how it can become acceptable for the educator and those educated – students and adults in certain conditions, and also for given teaching/learning situations

In changing educational conditions (lifelong learning, learning society) disciplinary didactics as a scientific discipline goes far beyond its influence in schooling/school education and into other areas and levels of formal, informal and self-education (e.g. adult further education, computer education, education supported by internet and media).

Question 2

This question was intended to analyse the flexibility of disciplinary didactics as a part of the teacher training curriculum with respect to changing concepts of education, teaching/learning and the teaching profession. It appeared that all didactics reflected new conditions and requirements of education at national as well as European level.

Didactics of the social subjects and arts mainly reflected changes in the methodology and changes of the content in these sciences.

As a consequence of the democratic tendencies of education in the Czech Republic, the plurality of didactical concepts and a willingness to consider various solutions to didactic problems and foreign attitudes was apparent.

A further phenomenon seemed to be the acceptance of European principles of education into the curriculum of several disciplinary didactics, for example, the European dimension, globalization, etc. The principle of inclusivity in schools and accessibility of subjects to all students whatever their intellectual level, appeared in the curriculum of many disciplinary didactics. Process-centred, activities-centred and student personality-centred approaches in teaching were dominant.

Question 3

As mentioned above, the most important part of the professional training of prospective teachers is disciplinary didactics studies. Therefore disciplinary didactics have a great responsibility in forming their professional competencies at a professional knowledge and skills level (Vasutova 1998). They influence the development of teachers' personality within a given subject. They also significantly

influence the students' attitudes and their teaching behaviour as prospective professionals. That should be the goal of disciplinary didactics education. These goals were only hinted at, though not fully formulated, by the workshop participants.

Apart from curriculum changes in disciplinary didactics, the concept of university teaching of disciplinary didactics is changing. The student is taken into consideration more as a person with developed communication and social skills, self-evaluation skills, problem solving and argumentation skills. Active and heuristic methods prevail within the teaching methods, as was clear during the workshops.

Here too barriers which made education 'difficult' in disciplinary didactics were mentioned. Standards in teacher education hardly exist. Among the problems are the student teachers themselves. Many of them have a negative attitude towards the profession of teaching but also towards the academic field/subject they study. Some students and graduates seem to wish to copy the negative patterns of practising teachers to "ease" their own entry into the profession. The greatest problem is the fact that graduates do not enter teaching. This is particularly typical of foreign language graduates, which of course has a negative influence on the educators of these didactics.

Questions 4 and 5

Professional teacher training will only be effective if all its parts (academic studies, professional studies and teaching practice) are in balance, correspondence and connection. Questions 4 and 5 were posed in order to identify the academic status, relationships and positions of disciplinary didactics with respect to the other disciplines represented in the teacher training programme.

Detailed information about the arrangement of disciplinary didactics within the teacher training programme were presented during the workshops. All the faculties differ and real connections were not proved. General didactics was identified as the contact discipline but it was not mentioned what are the main and contact points and where the "gaps" are.

There was a small criticism of the concept of the pedagogical-psychological programme (professional disciplines) from the side of disciplinary didactics and there was one request to direct this programme more towards processes of learning and teaching skills. Disciplinary didactics definitely should be in continuity with general didactics but in reality it is not.

As far as the relations with the academic disciplines were discussed, there were two requests: one was connected with the necessity for thorough knowledge of the scientific field by disciplinary didactics educators. The second was that professional knowledge should be formed not only through disciplinary didactics but also through scientific disciplines (academic disciplines).

On the other hand, it is logical that if general didactics is considered to be the overarching discipline, the educators of disciplinary didactics must also be qualified in this field and probably in other sciences of education. This point was not made however.

We came to one conclusion which concerns the competencies of disciplinary didactics educators. If disciplinary didactics has an interdisciplinary character then educators in this discipline should have an interdisciplinary knowledge. It is incomprehensible then, that the academic status of the disciplinary didactics educators should be lower than educators in academic disciplines and probably also in pedagogy and psychology.

Disciplinary didactics as a subject of the teacher training curriculum is often under-estimated by student teachers and viewed as an entirely practical discipline which can be avoided during their

studies. It is only the real professional competencies which can provide actual practice –is the opinion not only of students but also of some university teachers and teacher educators.

Summary

This attempt to reveal the problems within disciplinary didactics can be concluded by saying that it has given us a great deal of information and probably several suggestions. It cannot be said that it was possible to penetrate deeply into these problems within the workshops. But it definitely became apparent that disciplinary didactics are young sciences with considerable opportunities for their development, given the currently changing educational context and the increasing necessity for professionalization of teachers. There is a need to raise their academic status within the interdisciplinary communication field and for interaction with the educational environment. Disciplinary didactics educators should be more persistent with their didactics theories in contributing to the university level of teacher education. They should also withdraw from the practical approach which is often connected with disciplinary didactics.

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Teaching methodologies in initial teacher education: a preliminary evaluation of an experience

Abstract

This chapter outlines an integrated approach to subject methodology from a Portuguese perspective. There is a discussion of the results of a preliminary evaluation of the experience of this development. The importance of a competence-based approach in initial teacher education is recognised but the danger of an over-emphasis on skills and techniques is stressed. Competence is characterised as a broad issue that encompasses intellectual, cognitive and attitudinal dimensions, in addition to that of performance. The importance of language and communication is stressed, as is a constructivist perspective on student learning. The overall approach to this development is based on the view that there is a theoretical body of knowledge working as a common denominator across all the subjects involved (science, mathematics and humanities). The evaluation is discussed fully in the concluding comments and it is also noted that the integrated approach was also an attempt to avoid a reductive understanding in relation to their own subject area whether in the field of science or language.

The fundamentals of the study

Schooling and education should be based on the goal of everyone achieving success, rather than allowing success for some and failure for others. From this viewpoint it is relevant to look carefully at initial teacher education despite the authors' agreement with Brighouse (1996) that schooling and education should be based on the assumption that learning is lifelong, not a 'once and for all' activity.

The guidelines concerned with initial teacher education have to take into account such questions such as: How one views the education which one has received and also how one passes it on to others? How to help other human beings to learn? How to speak up for oneself, and how to take a hand in shaping the conditions of one's life? (Steiner 1996) In order to look for answers to those and other key questions it is important to develop a competence-based approach in initial teacher education. In the debate about the nature and value of competences we stress Whitty's and Willmott's warnings (1991) of the danger of over-emphasis on skills and techniques. They claim that what informs performance is as important as performance itself. This means that the whole is more than the sum of its parts. In other words, competence is characterised as a broad issue encompassing intellectual, cognitive and attitudinal dimensions, as well as performance. It makes sense to emphasize that some competences are person-related and some are task-related and that statements of competence must seek a combination of the two. On the other hand, the processes of personal and professional development are inseparable (Alarcão and Moreira 1993; Alarcão *et al*. 1994; Clough and Holden 1996).

In addition, and strongly related to the broad view of competence referred to above, it seems relevant to stress here the importance of the language and communication used by different teachers. Imagining and creating are at the very heart of language arts; being able to suggest several possible ways to explain an event is of crucial importance; becoming more critical about language usage, whether one's own or that of others, is also a dimension which should be taken into account. We argue that all teachers must pay attention to these and other aspects, moving towards a much more common and understandable language for students than that which is commonly used.

It is in this context that methodology subjects play a very relevant role in initial teacher education. Throughout this paper we propose to reveal and analyse an experience based on a particular assumption, that is that as far as methodologies of different scientific areas and the humanities are concerned, there is a theoretical body of knowledge working as a common denominator across all of them. This means that methodology nowadays is an area of knowledge with specific approaches, providing a set of suggestions and contents with a specific amount of useful information and attitudes (Praia 1995) which have to be taken into account during initial teacher education.

Methodology in the curriculum of Initial Teacher Education at the University of Aveiro

Behind all teachers' attitudes there is always a learning theory, because everyone who teaches or professes to teach has some sort of a theory of learning. In fact, action, whether a part of teaching or any other activity in life, must be linked with theory or it is blind and purposeless (Bigge and Shermis 1992; Schön 1983; 1987). Hence a theory of learning may function as an analytical tool, being used by its exponents to judge the quality of a particular teaching and learning event. Whatever the context in which the teaching and the learning process occurs, the latter is always a mirror of a particular theory of learning.

Teachers' learning is viewed here from a constructivist perspective which defines learning as a social process of making sense of experience in terms of extant knowledge (Tobin 1993). Therefore learning occurs in social settings, as persons interact to negotiate meaning and arrive at consensus. This constructivist perspective has to be taken into account both when methodology subject contents are defined and also when the types of approaches are selected. The contents should be related to the guidelines and suggestions provided by the several areas of research which are being developed in methodology. The sort of approaches selected have to take into account that student teachers need to become aware both that pupils are responsible for their own learning and that the teachers themselves should reflect on their own practices very carefully.

For a better understanding of the framework in which contents, approaches, students and lecturers interact in depth, it is relevant to explain the context of the Methodology component in the initial teacher education curriculum of our university.

Initial teacher education is carried out at the University of Aveiro for five years. During the first, second and third years, students in the different areas, i.e. broadly Science and Humanities, are faced both with subjects related to the central core of their scientific fields and with education issues, particularly Psychology, Sociology and the History of Education.

The set of subjects in the fourth year include, among other scientific subjects, the methodologies of the specific content areas the students are going to teach in the following year. These subjects are taught in the Department of Didactics and Educational Technology. The students spend the fifth year at a secondary school for a period of school practice. Throughout this time, the students work

under the supervision of two tutors: a secondary schoool teacher and a lecturer from the university. Sometimes they work under the supervision of four tutors (two from school and two from university) when their course involves the study of two main subjects, e.g. Portuguese/English.

It is important to stress that all these subjects deal with the teaching and learning process of specific areas of knowledge such as, for example, the native language, foreign languages, physics or earth sciences, which are taught at the University of Aveiro in the Department of Didactics and Educational Technology. Underlying this innovative view, among Portuguese universities, there is the assurance that, on the one hand different methodologies are supported by a common body of knowledge despite their specific issues and, on the other hand, that methodology has a very specific contribution for teacher education. This perspective started from lengthy discussions among staff members towards identifying a set of concepts (in the field of methodology) which were accepted and considered as relevant by all of them. Among the lecturers there was an agreement over those concepts: that they should be presented in all the specific methodologies. In other words, staff members recognised that, despite their own different backgrounds, their concerns with teachers' preparation had already achieved a satisfactory level of clarity about the methodological problems which should be tackled.

It is clear, therefore, that methodology helps students to reach a perspective of education based on the achievement of autonomy, solidarity, problem solving ability, reflection in action and a democratic attitude, rather than on a set of procedures which replicate previous knowledge and behaviours (Alarcão 1993; Andrade and Araújo e Sá 1989, 1990). In addition, instructional transfer (Chevallard 1999), a key issue the students will be faced with as future teachers, is also an important point to discuss and analyse in the Methodology component.

Guidelines of the experience

This experience started in the Department of Didactics and Educational Technology in 1997/98. The theoretical basis was the idea that there is a body of knowledge working as a common basis of the different specific methodologies. The opportunity for testing this view occurred when it was decided, by the Department, to take full advantage of the human resources of the staff.

For a better understanding of the context of this experiment it is useful to describe the structure of the subject under analysis during the first and second semesters.

There are strong reasons, in our opinion, for defining a common theoretical body of topics in Methodology and its organization which are relevant enough to be taught to students who are registered for several courses, i.e. from Science to Humanities (Languages).

First semester

A First Module was designed encompassing the following issues:

(i) Concept of Methodology: context of the subject in the curriculum of initial teacher education
(ii) Methodology in professional life: being a teacher has never been easy; methodology performance of the teacher
(iii) Methodology as a research field: research goals and techniques and tools of investigation
(iv) Communication in the classroom
(vi) Curriculum development and students' assessment

This set of topics takes four weeks. Two lectures of one hour each and a practical lesson of two hours are the weekly timetable of Methodology. All students of the different courses take the theoretical lessons together which are carried out by a group of lecturers; however for each course

the practical classes are given separately by a lecturer who is a specialist in this area.

A Second Module, taking seven weeks, was offered to two different groups: Science students and Humanities students.

For the first group the following topics were selected: models of science teaching, epistemology of science and the movement of alternative conceptions, the nature and the aims of experimental work.

For the second group, the Humanities students, topics such as comprehension and production of texts in the classroom, grammar study, the development of communicative competences were presented and discussed.

Figure 1 shows a synthesis both of the content of the two modules carried out during the first semester and the respective contents which are taught at theoretical classes.

A final comment relates to the criteria which supported the choice of lecturers who taught the first module. Despite the fact that an important group of members of staff work in the same area, i.e. Methodology, some of them have developed a more consistent and better organized view of the origin, the nature, the relevance and the aims of Methodology. Other members have, for example, reached a more in depth level of knowledge concerned with communication or with curriculum development. Therefore the lecturers with those profiles were responsible for lecturing the first module.

Second semester
During this period, Science students from different courses attend the same set of lectures during a six week period. They follow topics such as:

(i) The construction of scientific knowledge – epistemology of science
(ii) Communication in science classrooms
(iv) Information and communication technologies

During the last part of the semester – seven weeks– the students from different courses attend separate lectures.

The Humanities group is divided into two sub-groups: Modern Languages (French and English as a Foreign Language) and Classical Languages (Latin and Ancient Greek). Both sub-groups are expected to acquire competences in learning languages in the school curriculum.

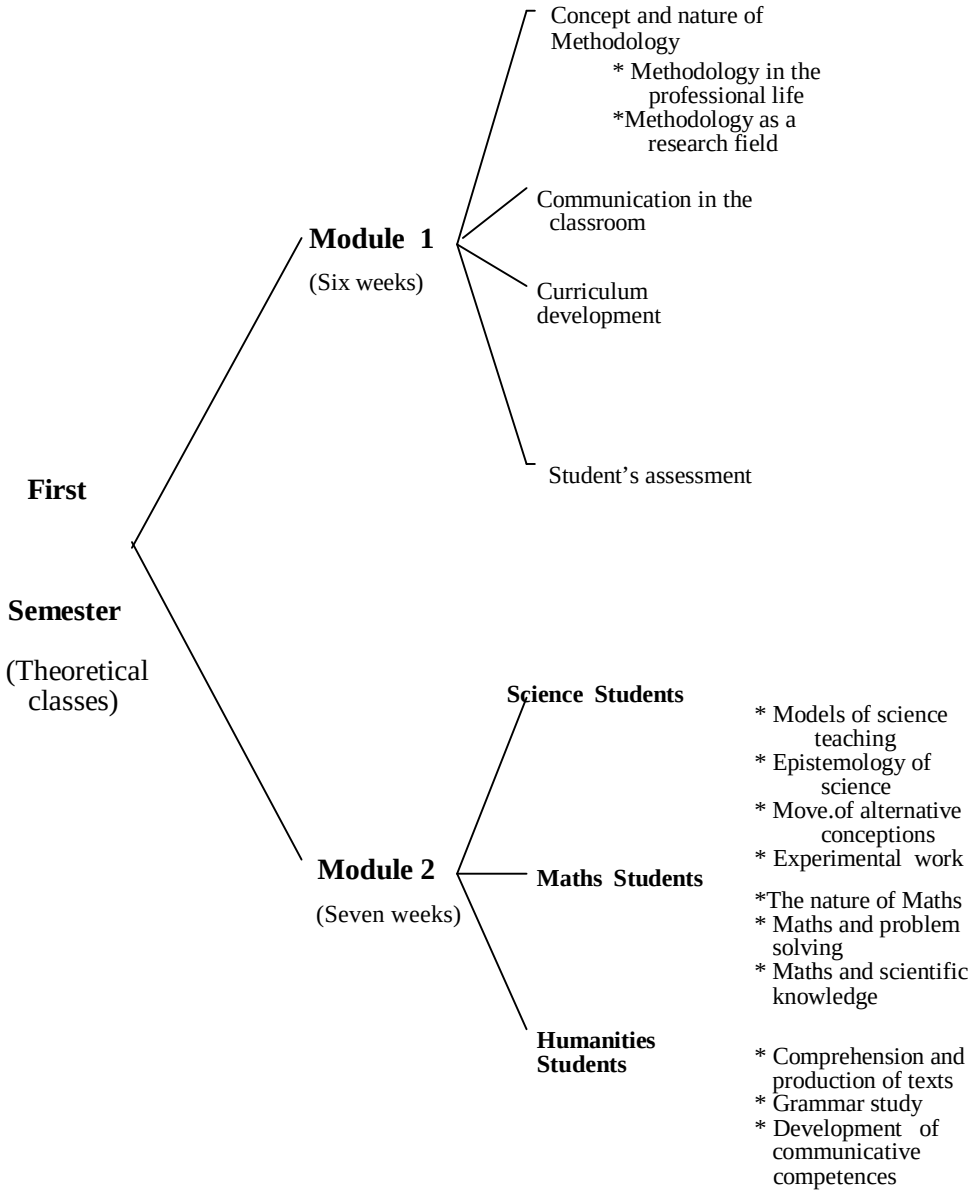

Figure 1 Synthesis of the contents integrating two models lectured during the first semester of Methodology

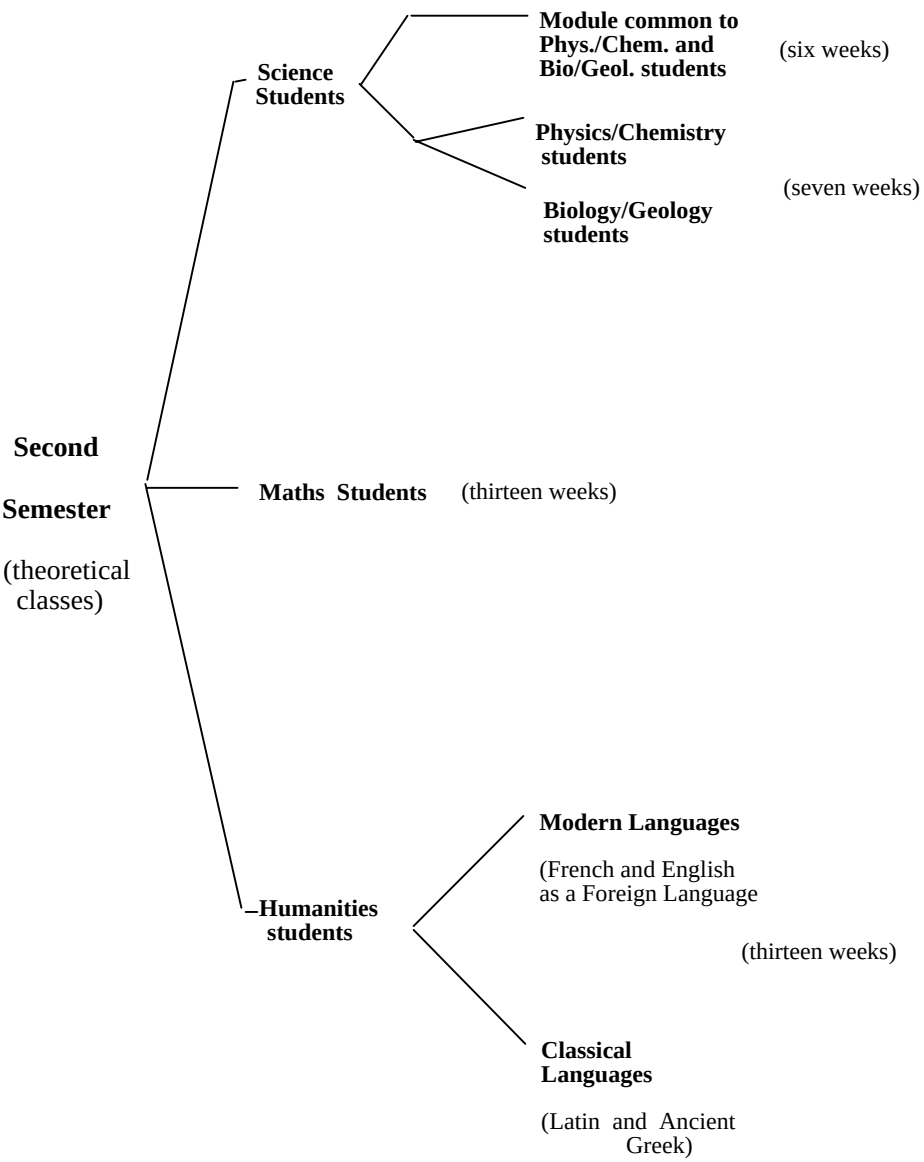

Figure 2 Groups of students from different courses in theoretical classes and contents taught in this semester

Figure 2 reveals the way students from different courses are clustered during the second semester.

Assessment of the experience

The assessment of this experience was carried out through the analysis of both the students' responses to a questionnaire administered at the end of each semester and the lecturers' responses. The questionnaire was designed by a team of colleagues from Science and Humanities. From the answers to these questionnaires we have attempted to discover:

1. the percentage of students from different courses attending the lectures
2. what the students think about the clearness and the organization of the different modules and how the students see the relationship between the topics taught in methodology and the contents of the other subjects of their courses
3. what the students' opinions are about the usefulness of methodology

4. suggestions from the students on how to reach better competence and attitude in the teaching and learning process
5. The views of lecturers in dealing with the development of the experiment and suggestions for further experiences

Analysis of the questionnaires at the end of the first semester

Students' Responses

Two types of questions were used in the design of the questionnaire. The first was a set of sentences which the students classified on a scale of 1 (not satisfied at all) to 4 (very satisfied). The second set offered open questions. Discussion of the results will be carried out in the sequence of the questionnaire referred to above.

Percentage of students who attended the lectures

The number of students enrolled in the 1997/98 year was 293 and almost 65% of them answered the questionnaire. As far as attendance of classes is concerned, answers reveal that 63% of respondents attended more than 75% of them. A small percentage (5%) only attended 5% of classes.

It is interesting to note the arrangement of the students from the courses under analysis. Students from Physics/Chemistry and Maths are those who attend the highest number of classes. Students from Biology/Geology attend the least. The other courses are in between.

Clarity and organization of the subject

A high percentage of students, 80%, gave answers revealing that the lectures are reasonably clear. Nevertheless, the students claim that the number of lecturers involved in this experience is inappropriate and should be decreased in the future; in fact it sometimes creates a lack of articulation between topics taught during the sequence of lectures.

The gap between the theoretical approach to the issues by the lecturers in their tutorials and the practical issues, which take place in the classroom, are stressed by students as the main reason for their dissatisfaction.

The sequence of the different contents of the subject is another topic analysed. For 75% of the respondents it was satisfactory. 12% revealed a high rating of dissatisfaction, while 7% showed a clear degree of satisfaction.

In relation to the sequence of contents, students from Maths are, once again, those revealing the highest degree of satisfaction. Students from Physics/Chemistry and Biology/Geology are less satisfied. The exaggerated number of lecturers involved is also pointed out by the less satisfied students as the main reason for the lack of an accurate sequence of the items which have been taught.

A satisfactory relationship between practical classes and theoretical ones is achieved in the opinion of more than 70% of our students. Whilst 12% reveal a very great agreement with the type of articulation which has been established, 9% disagree completely. It is interesting to emphasise that the students from Biology/Geology are those who reveal the highest level of satisfaction.

As far as the links between contents of the different subjects of each course is concerned, 70% of the students argue that they are satisfied. Nevertheless, the percentage of those who are dissatisfied is 20% while those who are very satisfied represent less than 5% of the sample. The main part of the latter belong to Language courses.

From the perspective of the students, the way the different topics are allocated in relation to the total number of classes was adequate. In fact, 70% of the respondents argue that they are satisfied in this respect. A high level of satisfaction is claimed by 25% and only 5% reveal no satisfaction at all. Nevertheless two thirds of the sample believe that more time should be assigned to this because four hours a week is not enough for discussing and making an in depth analysis of topics which are relevant for the student teachers.

Usefulness of Didactics
This is important, taking into account that students' opinions about the advantages and disadvantages of a particular subject play a crucial role in the amelioration of its design and organization.

As far as the importance of the content of this subject is concerned, more than 75% of respondents think that it plays a relevant role in the context of initial teacher education. The topics selected were regarded by 33% of the sample with a high degree of satisfaction; only 2% display complete dissatisfaction. The activities which the students were asked to carry out are considered to be of high relevance for more than one third of the students. The students from Maths and from Biology/ Geology are, once again, those who are more and less satisfied, respectively.

Students' views of the bibliography in the different modules, were also analysed in this section. This analysis looked at two aspects: length of the bibliography and availability of the titles recommended. Almost 85% of the respondents reveal satisfaction with this aspect. Whereas 10% claim that they are very satisfied, only 5% show considerable dissatisfaction.

It is interesting to note that 22% of the learners did not pass in this subject. Maths students achieved the best results.

Lecturers' Responses
The lecturers who have been involved in this study answered an open questionnaire, with four questions, administered at the end of the experiment. This was designed taking into account the students' views already identified. The aim was to look for lecturers' comments on learners' perspectives. The first question asked for a comment related to the following sentence:

Despite students having revealed broad satisfaction with the organization of this subject, they argue that there are too many lecturers involved and this is reflected in inaccurate links among the different modules and a lack of articulation between the theoretical and the practical classes.

The analysis of the comments revealed that most claim that it is possible to overcome this real difficulty. This can be done through the reduction of the number of lecturers and through the implementation of regular meetings. These should occur, on the one hand, during the preparation phase of the subject related to both the selection and the design of the topics and to theoretical and practical activities; on the other hand, periodical meetings for discussing the development of the process and increasing the links between the various topics are needed.

Another issue is related to the gap that the students feel between the theoretical topics which have been taught and concrete events closer to their future areas of teaching. The lecturers think that this perception is understandable but cannot be avoided. One of the main aims of methodology, after all, is to provide the students with a theoretical framework which helps them to take accurate decisions as future teachers. Therefore a theoretical basis should be achieved now and used afterwards for highlighting concrete aspects which occur in the classroom. It should be remembered that the common language was the curriculum area in which this experience was undertaken.

The third aspect commented on by lecturers was related to students' opinions about the short time available for in depth reflection and discussion of the topics taught. The lecturers agree that a smaller number of students per class would make it possible to increase the level of interaction, an aspect which is relevant for the personal and professional development of future teachers. A further suggestion was to increase the time available for giving support to students' activities.

The last question was concerned with future issues and the organization of methodology as a subject. Most of the lecturers recognise that it is crucial to improve the coordination of the different teaching activities. Producing written guidelines was suggested as an appropriate strategy.

Comparison with the response to the questionnaire at the end of the second semester

This section will be developed in two parts. First we will give short description of the organization and structure of the subject during the second semester. Next we will give a comparison with the results obtained in the first semester (rather than a detailed analysis of the answers provided by students and lecturers to the same questionnaires administered at the end of the second semester).

During the second semester Science and Humanities students never attend classes together. The number of common modules which the students took decreased both in Science and Humanities. In Science, for example, the students from Physics/Chemistry and from Biology/Geology spent six weeks together attending the same tutorials. These tutorials were related to three issues: problem solving in Science, the Movement of Science-Technology-Society, Technologies of Information and Communication in the classroom.

In Humanities, students were divided into‘ two groups. Students of Portuguese/French, Portuguese/ English and English/German were one group and students of Portuguese/Latin and Greek were another. Theoretical classes for the first group were taught by lecturers specialised both in English and French Methodologies. The content included the following: theories and processes of language acquisition, the evolution of foreign languages teaching methods, the development of communicative competences, the use of mother tongue, the teaching of literature and language policies.

For the last seven weeks of the semester, students from each course attended their tutorials separately. The topics presented and discussed were strongly related to specific aspects of the teaching process in relation to the variety of approaches of the content in the knowledge area of each course. Table 1 indicates the higher level of students' satisfaction, i.e. levels 3 and 4, related to a set of relevant aspects at the end of the first and second semester.

Main issues under analysis	**1st Semester (%)**	**2nd Semester (%)**
Achievement of the objectives	70	89
Clarity of topics of the subject	56	67
Usefulness of the subject	58	77
Articulation with practical classes	52	67
Time allocated to the various topics	47	38
Appropriate bibliography	70	89

Table 1 The figures represent the sum of percentages of the two highest levels of students' satisfaction revealed by the questionnaire

Let us now see what can be highlighted from the comparison of the results obtained at the end of the two semesters. The following points should be stressed:

- The students recognise that the approach which was implemented enabled an increase in the level of achievement of the objectives from the first to the second semester;
- In relation to thee organization of methodology, i.e. the articulation among the several modules, the results reveal that the number of students who have selected the levels 3 (satisfactory) and 4 (very satisfactory) increased from the first to the second semester. Nevertheless, when the relationship between the contents taught, either in methodology or in other subjects is analysed, the figures are no different from those obtained in the first semester. This is understandable taking into account that the strategy to overcome this shortcoming, i.e. the lack of relationship, needs to be based on an innovative overview of several aspects of the course as a whole, rather than on a particular change in the contents of a set of subjects;
- As far as the relationship between the contents covered in the theoretical and practical classes is concerned, there is a substantial difference. The percentage of students selecting levels 3 and 4 was 52% and 67% in the first and second semester, respectively. A detailed analysis shows that level 4 (highest satisfaction) was selected at the end of the first semester by 20% of the students while 48% chose that level at the end of the second semester.
- However the students at the end of the second semester still reveal dissatisfaction with the time allocated to the various topics taught. This is based on the view that in the second semester the students were better able to recognise the relevance of methodology for their training and would have liked more time for in depth discussion of the various issues;
- Students' opinions about the usefulness of methodology also increased by c. 20% at the end of the second semester, compared with the first one. This suggests that probably the approach taken to towards issues in their courses in the second semester helps them to understand the relevance of Methodology;
- In relation to some general aspects such as aims, bibliography and the content of the subjects themselves, the rate of satisfaction is higher at the end of the second semester than at the end of the first.

Final comments

From all that has been said above, we consider that:

- The assumption that a common body of knowledge in the field of Didactics exists and can be taught to future teachers of different areas, from Language to Science, was supported by the students' opinions. In that respect it can be said that the experience was successful. The main problem that exists is in aspects of organization, namely, the number of lecturers involved, as well as the articulation among them, and also about the lecturers responsible for the practical classes.

- From the point of view of staff members involved in this experience, it should be stressed that they recognize an enrichment of their own experiences as lecturers responsible for several subjects in the knowledge area of Didactics. This enrichment emerges mainly from the opportunity to develop systematic discussions; they are nourished by different personal views which are rooted both in different scientific backgrounds and the professional experience of each of the lecturers. In other words, it makes sense to emphasise that the endeavour to look for a conceptualization and organization of a particular part of the content of the subject, i.e. the *Common Module,* gave the chance for increasing more in depth dialogue among the lecturers .

- The designing of a more uniform curriculum of initial teacher education, at least in its final part (fourth year), could also benefit from this experiment. The issues which were taught to all the students who will in future be teachers, simultaneously, provide them with a broad and balanced

useful framework. This enables both the identification of difficulties occurring in the classroom and the attempt to look for the most appropriate solutions to the problems they will be faced with in school.

- Another important aspect, particularly related to Science students, is concerned with their achievement of a more systemic view about Science teaching. This is strongly linked with the recommendations suggested by several educational institutions and educational research teams (NRC 1996; Mayer 1999). Students from the different Science courses in this experiment were all presented with the same issues, at least during the theoretical classes. This gave them an overview about the links between teaching different content belonging to the traditionally different areas of Science such as, for example, Physics or Earth-sciences. In other words, this approach also attempts to avoid students' reductive understanding in the teaching of their own area of Science. The same thing happens with Language students because they can discuss the role played by each language in the curriculum (Coste, Moore and Zarate 1997).

- The last point relates to the bibliography. The high level of satisfaction revealed by the students has, we believe, an interesting significance. Taking into account that the subject under discussion was organized in an innovative way and the students with different scientific backgrounds were, at least during an important part of the first semester, faced with the same set of contents, the corresponding bibliography should be adapted to this perspective. Two viewpoints seem to be behind the responses of the students: on the one hand they understood the approach implemented because they recognised a strong relationship between the content taught and the nature of the written texts provided by lecturers; and on the other hand, through the literature, it was possible to find an appropriate bibliography underlining the idea of the existence of a common body of knowledge as referred to above. In spite of this the level of satisfaction increases at the end of the second semester. So there is still work to be done on this aspect.

- An in depth assessment of this experience has to take place; it should be carried out through interviews with the students and lecturers involved. Interviews are more accurate tools to identify both the real shortcomings which exist and to design appropriate strategies for overcoming them.

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The role of subject didactics in teacher education The case of the Department of Didactics and Educational Technology at the University of Aveiro, Portugal

Abstract

This chapter begins by addressing the meaning of didactics and identifies three interrelated dimensions. Firstly it may refer to research on teaching and learning which is seen the research component of didactics. Secondly it may refer to what teachers do when they teach which is referred to as the professional component. Thirdly consideration is given to didactics as a learning course of study in teacher education programmes and this dimension is called curricular didactics. It is noted that the field of didactics in Portugal has evolved from a practical, normative field of instruction to an inquiry-based, meta-disciplinary area of teacher learning, professional practice and research. The epistemology of subject didactics is seen to have revealed it as a field of generation of new knowledge that goes beyond subject disciplines and the sciences of education. It is seen to subsume the common dimension of teaching (general didactics) and to interrelate this to the content dimension of teaching. Its integrative, interdisciplinary nature is seen to have brought to light the mediating role of the teacher in the pupils' approach to content knowledge. The underlying focus on research concerned with what teachers and pupils actually do and say in their interaction in learning situations has represented an attempt to relate knowledge and action. The involvement of teachers in research projects is seen to have helped to turn didactics knowledge into professional innovation.

Introduction

In our view, the term didactics is misleading. Because of its too broad range of meaning, it takes on different semantic nuances. A clarification of what one means by didactics is a point that deserves consideration. Sometimes one has in mind research on teaching and learning. In this case we are in the presence of the research component of didactics. Sometimes the focus is on what teachers do when they teach. This can be called the professional component. But one has also to consider didactics as a learning course of study in teacher education programmes, a dimension which will be called curricular didactics in the context of this paper. These three dimensions are interrelated and it is interesting to explore how they relate.

Traditionally in Portugal, the field of didactics has evolved from a practical, normative field of instruction to an inquiry-based, metadisciplinary area of teacher learning, professional practice and research. In our country traditional general didactics tends to be replaced in teacher education programmes by subject-specific didactics, though a need for a common core knowledge is not to be neglected. Since the early 1980s academic degrees (masters, PhDs) on subject-specific didactics have fast grown and the field is in great development. Special attention has been given to it at the University of Aveiro, in Portugal.

In this paper we explore the development of this area in our university, taking into consideration the institutional, teaching/learning and research issues as well as its impact on teachers' professional development. We think it can be looked upon as a case of innovative practice and theory-building in the context of a new university.

The University of Aveiro commemorates its 25th anniversary this year.

Subject didactics at the institutional level. Staff development

In the seventies great changes occurred in the field of teacher education in Portugal, one of them being the assumption of teacher education at the higher education level (universities and polythecnics). Until that time teacher education for secondary school level took place through a supervised teaching practice period in schools after a first academic university degree. Primary school teachers were educated in special schools, the so-called "Escolas do Magistério" (Schools of Education).

After that period teacher education programmes were progressively offered by universities and higher schools of education integrated in the polytechnic context. The University of Aveiro in the central-northern part of Portugal, near the coast, was one of them. The first programmes, for secondary school teachers, started in 1975. Twelve years later the institution expanded teacher education to infant and basic school levels. The Integrated Centre for Teacher Education as part of the University of Aveiro was founded in 1978.[1]

Teacher education programmes at this university have always comprised general, academic and professional studies as well as teaching practice. Within professional studies, the relevance of subject specific didactics in the different disciplines was considered from the start and an investment was made to recruit and qualify members of staff in these fields. At first, recruitment fell mainly on secondary school teachers. Due to lack of research on didactics in national centres at the time, these newly recruited teachers were sent to study abroad for their doctoral degrees. England and France were the most frequently selected countries. The first foreign PhD. in the field of Didactics was recognized by our university in 1982.[2] Other staff members attending similar courses abroad returned to the country shortly after.

Notwithstanding the existence at the university of a department which integrated staff members dealing with educational subjects, the so-called Department of Educational Sciences, not all newly recruited members in Didactics were allocated to it as the field was disputed among this and the subject-specific departments (e.g. Physics, Chemistry). Difficulties in interdepartmental interactions and institutional policy-making, associated with the recognition of a common core of interest among the didactitians were the origin of a proposal made by them for the foundation of a Department of Didactics and Educational Technology. The proposal was accepted by the university committees. The department started in 1986 and integrated all staff members willing to join and whose teaching and research interests fell in general or subject didactics and educational technology as well. If, in a sense, this occurred to facilitate bringing together colleagues working in the same new emerging area, it also reveals an awareness of the commonalities to be explored beyond what is specific to the teaching in each subject.

Since 1982 eight doctoral students have presented their research dissertations and been awarded the degree by the University of Aveiro, now capable of supervising not only their own staff members but also candidates from other higher level institutions or from schools who demand the university to offer post-graduation courses. The first degrees were conferred in Didactics as a branch of Educational Sciences. They are now conferred in Didactics as a major discipline. This movement towards emancipation is evidenced in other contexts, as will be demonstrated below.

Teaching and learning subject didactics

Parallel to the strategy for staff development ran reflection on the nature of the teaching of didactics as a course of study. This curricular dimension, as described above, was given high priority by staff members in the early 1980s mainly in what concerns subject didactics. Though it was motivated by the existence of courses to be run, this concern cannot be justified by a practical need only. A hidden dimension was the staff's awareness that the integration of a new field in a university context demanded an effort to make it academically acceptable. It was not an easy task as didactics was seen as a mere collection of a-theoretical techniques which were taught to teachers-to-be. The challenge was great and the search for identity, credibility and autonomy in a still ill-accepted domain was reinforced after the foundation of the department in 1986 and it has had a strong impact on colleagues from other fields.

Evidence for the conceptualization of the new disciplinary domain based on an epistemological delimitation of the field contours is shown in:

a) Several published and unpublished papers on the topic (Alarcão 1982, 1984, 1989a, 1989b,1991, 1994, 1996, 1997; Alarcão e colaboradores,s.d. 1994, 1995; Alarcão e Moreira 1993; Andrade e Araújo e Sá 1989, 1990, 1991; Andrade, Araújo e Sá Moreira e Sá 1997; Andrade *et al.* 1993; Moreira 1991, 1992; Sá 1991; Thomaz 1991)
b) Theoretical thinking presented in the context of academic staff promotion activities such as examinations and post applications (Alarcão 1985, 1989c; Andrade 1988; Araújo e Sá 1988; Cachapuz 1993a, 1993b; Costa 1994; Martins 1995)
c) The action-research project EURECA-DL.[3] Growing out of the issues underlying a) and b) before and the recognition of lack of congruence between lecturers' conceptualization of didactics and students' representation of the same course of study, the project gathers all lecturers of language didactics and aims at the development of students' understanding of the nature and role of subject didactics in the construction of professional knowledge as well as at the development of teaching-learning and self-access materials for the study of didactics. Its action-research approach contributes to the further professional development of lecturers themselves as one of the agreed aims.
d) The organization of the two first National Seminars on Subject-specific Didactics and Methodologies, held at the University of Aveiro in 1988 and 1991. We should point out that the discussion of the nature of didactics was one of the objectives set for the seminars, namely the second one. The key conferences and the accepted papers fell into three headings: Didactics as a Course of Study or Curricular Didactics; The Teacher of Didactics; Research on Didactics; clear evidence for the priorities given to research and teaching.
e) A study by a research team, involving several members of the department and one from the University of Minho, carried out to describe the state of the art about Language Didactics courses at a national level through a comparative analysis of the syllabuses taught at several institutions (Andrade *et al.* 1993).

Evidence for the evolution of theoretical thinking on Didactics at the University of Aveiro can be traced in the way teachers have conceived their discipline and reflected on its epistemology, autonomy and position in relation to other disciplines. Three steps can be identified.

At the beginning, subject specific didactics, mainly in the language area, was seen as a discipline in the Sciences of Education. This step corresponds to a period which goes up to the mid 1980s and is evidenced by:

a) the institutional affiliation of language didactics courses to the Department of Educational Sciences;
b) the existence of General Didactics and Evaluation as prerequisite courses to subject specific didactics and common to all students of teaching. The underlying rationale pointed to specific

didactics as an applied field of general didactics. The courses were very much practice-oriented, embodying a teaching methodology approach based on a view of the teacher as a technician rather than as an educator.

c) the integration of two didactics-oriented branches (Didactics of French in 1983 and Didactics of English in 1985) under the general umbrella of masters' degree courses on Sciences of Education.

The second step is characterized by a self-closing attitude of the area. The staff members concentrated their energy in demonstrating their competence to provide answers to specific questions which could be answered neither in the context of Sciences of Education nor in the context of academic subject disciplines. Their object of study was identified as the teaching-learning classroom situation, a reality that should be recorded in order to be analysed and practised. A practical concern was highly present and the teaching act was considered essentially at the interactive level according to the classical six questions: who, when, what, where, how, why. According to a study of the course syllabuses at the departmental level (Andrade e Araújo e Sá 1989), several courses aimed at the development of students' specific skills to make practical decisions in the profession they would shortly embrace. However, the presence of some more theoretical perspectives was to be found. This period goes up to the mid 1990s, which was also a time when alliances were made with members of staff in the so-called educational technology area. Some didactics teachers took on a responsibility to teach classes on educational technology and the use of materials produced in educational technology courses were used in learning didactics projects.

The third step, in the 1990s, corresponds to a phase of consolidation. The growing maturity of the field is shown by:

a) The introduction of a module on the epistemology of the area at the start of the subject-specific didactics courses as evidenced by the analysis of syllabuses produced in 1997–1998;
b) The closer articulation of research, teaching and learning. The comparison of the course syllabuses in 1989/90 and 1997/98 reveals references to outcomes of research, inclusion of bibliography on research methodology, introduction of a unit about objectives and methodology of research on didactics, production of texts on these topics to be used by students, as well as the development of small research projects as a learning strategy;
c) The establishment of relationships among didactics courses on several subjects. This is clearly evidenced in the introduction of a common introductory unit taught to all didactics students in which transdisciplinary topics, such as didactics as a course of study, i.e. the nature of curricular didactics, curricular development, classroom discourse, evaluation, are theoretically discussed before being contextualized to the different subject areas in practicals and tutorials. This approach established interdisciplinary dynamics and has contributed strongly to the development of a better conceptualization of the nature of the field and its role in teacher education;
d) The further linking of didactics to educational technology, namely in the common use of laboratories for production/observation of teaching materials, so bringing added value to both areas;
e) The course content movement from an a-theoretical description of what happens or should happen in class to an analysis at a deeper, conceptual level, a trend which corresponds to a research-oriented perspective on the teaching of didactics. This also reflects a better education of didactics teachers. The didactic questions are now framed and answered in a more holistic, interpretative, problematizing, rational perspective, more in line with the conception defined by Alarcão in 1991.The relevance of didactics knowledge is accepted because didactics developed its own way of looking at its object of study and learned how and when to appeal to knowledge in other fields;
f) The use of case study methodologies and task-based approaches as learning strategies which require students to look at problems from a didactic point of view, as different from other disciplinary ways of looking;
g) The autonomy of the masters degree on Language Didactics due to start in October 1998 in relation to the masters' degree on Sciences of Education with branches in French Didactics and English Didactics.

To sum up this section on subject didactics as a curricular field of study in teacher education programmes, we take the view that it should build a thorough multireferential theoretical framework for conceiving the teacher/student interaction in learning environments. To be effectively formative, the course should promote an exploratory, analytic and reflective attitude in learning teaching.

It is not easy to define subject-specific didactics as a course of study. Andrade *et al.* (1993) define it as: a theoretical-practical discipline, integrating pluridisciplinary contributions to knowledge, interpretative (as a field of description/interpretation of teaching/learning processes and situations), exploratory (as an opportunity to re-construct pedagogical knowledge) and promoting analytic, reflective learning situations (as opportunities for personal theorizing on teaching and learning rather than training based on good teaching models).

Alarcão (1991), after several years of experience as professor in this field, attempted a multidimensional analysis of the discipline and came up with the following characteristics of a subject-specific didactics course: analytical, rational, interface, synthesis, heuristic/research, reflective, metacognitive, constructive, transforming/innovative, projective, clinical, praxeological, metapraxeological, interactive, prospective, selective, formative, autonomous.[4]

Research on subject didactics and impact on school teachers' professional didactics

In this section we will give a brief picture of the nature of the research carried out and make some comments on its organisational structures.[5] We will also consider its impact on school teachers who are now becoming the great majority of our post-graduate students .

Research activities were relatively few in the early and middle 1980s, because of lack of qualified researchers. The allocation of members of staff to different departments as mentioned before did not help to create a research community in the discipline. The staff development policy and the foundation of the Department of Didactics and Educational Technology made the difference. The research activities productivity, measured by the number of research projects and publications, has increased and the numbers are still increasing. A comparison shows one research project and no publications in 1981 against 21 research projects and 15 publications in 1989, three years after the foundation of the department. The numbers are still increasing.

The organisation of research in a research unit to be financed by the Portuguese Ministry of Science and Technology is another relevant point. The unit, named Didactics and Educational Technology in Professional Education, started in 1994. It integrates all the members of staff in the Department under consideration in this chapter as well as members of other departments in our university and in other Portuguese universities who share the same research interests. Although, as the name of the unit may suggest, some participants' interests go beyond didactics, e.g. Continuous Professional Training, Teacher Education and Supervision, didactics occupies a central role. Let us take the supervision research activities as an example. Supervision is, in our view, strongly linked to didactics. A clear evidence of this perspective is shown in the structure of the masters degree course on supervision run by the department. It is organized in branches according to different subjects (Language education, Science education, Infant and Basic education).

Another contribution by the research unit was the integration of research projects on research lines. The identification of three main areas of research, namely Interaction in School Didactics, Initial Teacher Education and In-service Teachers and other Professionals Education brought projects into a more coherent research picture. In other words, the projects under development are now seen as part of the whole research activity.

The main advantage of this organisation is the existence of a "new space" where research activities can be jointly planned, implemented and discussed in a general framework in which aims become more explicit and commonly agreed.

Internationalization is among the objectives of the research unit. Again, a comparison may help us understand the development. In 1988, before the existence of the research unit, four international research projects were run and five papers had been published in international journals. In 1996 there were 14 projects and 13 publications.

Let us now turn our attention to the nature of the research done. A detailed descriptive analysis and evaluation of the nature of the research developed does not fit into the context of this paper, despite its interest. Therefore we decided to pursue a general overview of the main focus of the research projects to show the degree of congruence between the object of research studies and the priorities given to the teaching of subject didactics, defined above as the critical analysis of the teaching and learning processes of a specific subject matter in a given context.

Research studies fall into four categories: learning, teaching, teaching and learning, development/ evaluation of curricular materials. There has been an increase in the number of projects focusing on the teaching and learning process of a given subject matter, thus corresponding to the subject-oriented view of the role of didactics in teacher education programmes adopted by the staff members. To the increasing interest on teaching and learning processes corresponds a decreasing number of projects on development/evaluation of curricular materials. The existence of projects on classroom interactive discourse corresponds to recent developments in the department.

We also inquired whether the studies were developed by individual researchers or in research teams. From our point of view the second alternative is more in line with the complex nature of construction of didactics knowledge which requires a strong link to practice and the involvement of practitioners as well as academics. The result of our analysis at two dates (1986 and 1996) showed seven team projects in 1986 and ten in 1996. As far as the individual projects are concerned they were nine in 1986 and 16 in 1996. Our hypothesis did not therefore prove to be right and an interpretation had to be found. The situation could still be the result of individual staff members doing research to doctoral degrees (four in the recent past). But it is certainly a consequence of the increasing demand of our school teachers to attend our post-graduation courses.

This last statement raises a point deserving some consideration, namely the extent to which these projects are or should be integrated in the supervisors' research areas. Reacting against the natural motivation in basic and secondary school teachers to follow closely their own immediate interests, university supervisors are trying to make these research projects fit into the research strategy under development in the research unit, as a way to build a strong coherent body of knowledge on the practice of teaching.

Another aspect of relevance is the effort made to develop research at the primary school level. As seen earlier the integration of primary school teachers at the university is a recent trend in Portugal. The University of Aveiro accepted that challenge and initiated the courses for this level in 1987. Conscious of the need for closely linking teaching to research we are re-orientating our studies in order to embrace all levels of teaching.

Still on the topic of research some comments about our involvement in post-graduation courses are to the point. The relevance of running post-graduation courses in this area was recognized by the university by the early 1980s, even before the foundation of the Department of Didactics and Educational Technology. As explained before, Didactics of French and English were taught in the 1980s under the general umbrella of master's degree courses in Sciences of Education and are now

replaced by a master's degree in Language Didactics with the collaboration of the Language and the Educational Sciences Departments. The same trend was followed when a master's degree in Sciences of Education with branches in Supervision on different subjects was replaced by a course on Supervision in different branches. The department is totally in charge of both courses. A masters' degree on Educational Technology is still closely connected to Sciences of Education.

The Department shares with the Departments of Physics and Chemistry the responsibility for running the master's in Physics and Chemistry Educational Methodologies. Similarly with the Departments of Earth Sciences and Biology in what concerns the master's on Educational Methodologies in these fields. Staff members also collaborate in the master's course on Teaching of Mathematics run by the Department of Mathematics.

Finally we will consider the nature of our postgraduate students. The first courses were attended by a high percentage of staff members of universities or polytechnics. The attendance by school teachers has progressively increased. Several reasons underlie this movement: limited recruitment of new staff by universities or polytechnics, more postgraduation courses available, legislation fostering promotion of school teachers after the completion of postgraduation courses, greater awareness of school teachers relating to relevance of research in their professional development.

This new trend is contributing to the establishment of closer links among research on didactics and what we described above as professional didactics. Indeed, the interplay among the three dimensions of didactics mentioned at the beginning of this paper is evidenced in the objectives of the research unit, namely to:

- develop further research about teachers' and students' oral discourse interaction in different subjects and levels of schooling as a result of our understanding of the interactive constructive nature of students' access to knowledge;
- develop innovative methodologies concerning the teaching of Didactics (curricular dimension) in accordance with a constructivist view of learning teaching;
- produce didactic materials and evaluate their impact of use in schools;
- organize activities for professional development of teachers, namely in-service training programmes, post-graduation courses, action-research projects;
- disseminate results of research studies through paper presentations, publications and didactics reports.

Conclusion

In this paper we have tried to demonstrate the development of a newly-established field, namely subject didactics, in a university setting. The search for the identification of an innovative self-defining idea based on an epistemological definition of the discipline contours, associated to a careful staff development policy, are highlighted as the touchstone for the development of a distinctive change-oriented self, a specific professional culture and an emerging body of knowledge. Cutting across traditional departmental lines, a new department was founded. The development of a research unit, integration of research, advanced training, development of students' constructive and reflexive learning processes, collaboration with practitioners in schools, all proved to be relevant issues.

Central to the accomplished development was the search for the answer to the question about the role of subject didactics in teacher education, either initial or further. Considered as essential since the start of teacher education programmes in the early years of the university, it required a careful staff development policy

The epistemology of subject didactics has revealed it as a field of generation of new knowledge that goes beyond subject disciplines and the so-called sciences of education. It subsumes the common dimension of teaching (general didactics) and interrelates it to the content dimension of teaching. Its integrative, interdisciplinary nature brought to light the mediating role of the teacher in the pupils' approach to content knowledge. The underlying focus on research into what teachers and

pupils actually do and say in their interaction in learning situations has attempted to relate knowledge and action. The involvement of teachers in research projects has helped to turn didactics knowledge into professional innovation.

Notes

1. On this, see SILVA J.L., THOMAZ, M.F. and ALARCÃO, I. (1981).
2 This research combined didactics and supervision which is interesting to understand the development of the area. We refer to ALARCÃO e SILVA (1981).
3. EURECA/DL stands for Ensino Universitário Reflexivo, Chave para a Autonomia/Didáctica das Línguas (University Reflexive Teaching, Key to Autonomy/Language Didactics).
4. For a full in depth description of these characteristics, see ALARCÃO (1991) or ALARCÃO e MOREIRA (1993).
5. Data are supported mainly by information contained in booklets published by the University. See:Guia da Universidade de Aveiro (1981–82); A Investigação na Universidade de Aveiro (1987, 1994), Relatório de Execução Científica e Financeira da Unidade de Investigação Didáctica e Tecnologia Educativa na Formação de Formadores (1997).

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Overcoming the gap between theory and practice in subject teacher education. The role of subject didactics, general didactics and the theory of pedagogical action

Abstract

This chapter discusses the role of subject didactics, general didactics and the theory of pedagogical action in relation to the problem of overcoming the gap between theory and practice in subject teacher education. It gives an account of how the teacher education curriculum was re-orientated around a general perspective on the concept of "pedagogical action" from within the German tradition of Allgemeine Pädagogik. The idea of pedagogical action is seen to form the core in education and is based on four principles. The first principle "Bildsamkeit" refers to the initial ability of the student to learn and develop herself. The second principle "Aufforderung zur Selbsttätigkeit" means that educators act themselves in the way that later on requires the student to realise his/her ability. The third principle is "Contextuality" and involves coming to know the cultural context and acquiring the competencies that are needed in this context. The fourth principle is "Bildungs Ideal" which involves thinking about the future that is aspired to and the competencies that are needed for the students to improve their own contexts. These pedagogical principles are seen to have a dual role in the development of teacher education. They form the basis of the structure of the curriculum, and also should form the basis of methodology of teacher education. The structure of the curriculum is aimed at bridging educational theory and practice and at trying to bind together special and general tasks of didactics in every level of study processes. From initial evaluations this structural reform is seen to have helped students to see their studies as a whole where theoretical and practical, general and special knowledge are integrated with each other.

Introduction

The aim of theoretical educational studies has been that the student teachers who will later graduate to teachers learn to apply the theoretical models and theories in their teaching. However, many studies suggest that there is a gap between what is taught by university lecturers and actual instructional action. The education of subject teachers has been evaluated at many levels. The working groups of the Ministry of Education have studied education, universities have evaluated their own curricula and their implementation, the Faculty of Education and the Departments of Sciences have also evaluated the instruction from their own point of view.

According to the Finnish development committee of teacher education, one of the problems in teacher education in Finland is a lack of cooperation between the Faculty of Education and the Departments of Sciences. Educational studies and studies in sciences are not integrated with each other. Therefore the students feel that educational studies link neither with science studies nor with

each other. However, school practice and studies of subject didactics have been integrated better with subject content. (Opettajankoulutuksen kehittämistoimikunnan mietintö 1989, 26)

In the Department of Teacher Education in Oulu, the conception of the lecturers concerning problems in educational studies are quite similar to those of the students. Pedagogical studies were evaluated as being the weakest and school practice the strongest area in teacher education. In the opinion of both educators and students pedagogical studies were atomistic. The studies in subject didactics were said to be too theoretical (Leppäjärvi and Törmi 1996). In a new report, the opinions of teachers were similar to the earlier one. Studies should be more practical, as they were at the beginning of the 1990s (Kauppinen 1998). According to the report of the development group of pedagogical studies in Oulu University, the greatest problem in pedagogical studies is that students cannot construct a holistic view of the structure of educational action (Opettajan pedagogisten opintojen kehittämistyöryhmän raportti ... 1996).

Teachers' work takes place in individual situations and in very individual ways. Acting in the right way in these situations is not always easy – especially not for student teachers. So it is quite understandable that students often do not much appreciate any highly theoretical models and reflections on education and didactics. They would much prefer to receive very concrete and practical solutions to the typical problems they think they will meet in a classroom. These kinds of concrete models will obviously help them to manage in certain kinds of practical situations. But these models will not help them to solve educational problems in a creative way and they are probably not able to grasp the individual nuances of the situations. This kind of practically oriented training would lead to the same result as a rigid normative theoretical binding. After teachers have familiarized themselves with their work and developed a routine they will discover that without more profound theoretical insights their work is not challenging enough and they will become bored or even burn themselves out (cf. Kauppinen 1998).

Attempts to bridge the gap between theory and practice are vital in preparing future subject teachers. New solutions are necessary for integrating school practice, instructional knowledge and educational research in their education. The central aim is to help student teachers to see instructional situations as educational challenges which are to be solved with the help of educational theories. This is of course a great challenge for teacher education. Nowadays, it is a far greater challenge because of the new law which has extended the qualifications for becoming a teacher. This new legislation means that a teacher with pedagogical studies in one subject is a qualified teacher for almost all school levels in any new subject if s/he takes the degree of intermediate level in this new subject. So our pedagogical studies with subject didactic studies in certain subjects should give the pedagogical qualifications for teaching these new subjects, too. This situation strongly emphasizes the importance of general theoretical readiness in questions of education and instruction.

The concept of pedagogical action and student centered ideas of didactics as a foundation of the curriculum

In the Department of Teacher Education of the University of Oulu, we started to reorientate our curriculum, acknowledging that there are different kinds of knowledge about education. We thought that these gaps between theory and practice, between description and prescription, etc. couldn't be simply and easily removed. On the contrary, we observed that these areas should on one hand be developed independently and on the other brought more effectively into communication with each other than we have done so far. There are important normative views about certain educational situations, and special knowledge about subject didactics, which should be maintained, developed and taught to students. Consequently, to offer an integrated view of all these topics we felt that we

need a much more general theoretical insight into the concept of education as a whole than we have had before (Opettajan pedagogisten opintojen kehittämistyöryhmän raportti… 1996).

We started to build this general outlook on theoretical research into the concept of pedagogic action conducted for a couple of years in our faculty. This research has mainly been based on a German tradition of Allgemeine Pädagogik (see Oelkers 1997). According to this, the core concept of the theory of education is pedagogic action. The basic theoretical problem in this concept is the "pedagogic paradox": how to combine the necessary compulsion in education with the freedom of the student, as Immanuel Kant formulated it in his lectures in pedagogics (Kant 1992). The aim of education is to produce a free, rational and autonomous human being. The educator has to use constraint to alter the student toward that goal, but how can a non-human, unfree creature change to a free and rational human being? Can it be forced to go through this radical transformation? No, rather it must already have been a being like that. Consequently, the educator must not and even could not compel it to change. In a paradoxical way it seems that the educator must, and must not, influence the student who is, and is not, a free, rational being. The consideration of this theoretical problem forms the explicit basis for the Allgemeine Pädagogik tradition and also an implicit basis for almost all other traditions of educational thought.

From this point of view, it is obvious that the concept of learning is not a sufficient starting point for the theory of education because it is restricted to just one side of the paradox. The concept of learning is central in educational psychology and quite important also in recent didactics, especially in the constructivistic approach (e.g. von Glasersfeld 1993). However, if the considerations in these areas are implemented, we soon find that there are some other points overlapping it. Education is never orientated only according to learning but includes other values and aims which define which kind of learning is good learning and what contents or abilities the student should learn. These values and aims are in one way or another set by the educator of the learning subject.

This narrowness of the concept of learning suggests a more traditional concept, namely that of teaching. But in the same way it is insufficient, at least if it is understood behaviouristically as causally affecting the changes aimed to be produced in the student. Theoretically we cannot show any causal connections between the actions of an educator and the learning results of a student (Oelkers 1982; van Manen 1991). The student interprets the action of the educator and decides for him/herself how to react to it, and the learning is mainly dependent on the learner's own action. The influence of the educator on the learning of the student is mediated via the interpretations and actions of the latter.

These aspects of interpretation and autonomy lead to the third main area of pedagogical action. The so-called critical approaches in education have stressed the concept of dialogue or communicative action. Originally this concept describes the moral ideal of the relationships between competent and equal adults. The dialogical relationship presupposes that the participants use the same language, understand each other, have a common lifeworld, tell each other honestly all that they know and think about the topic under discussion, etc. This kind of relationship can be regarded as the ultimate goal of education, although empirically it can be considered to be realised very rarely. However, education itself can hardly be considered as pure dialogue.

One of the most modern and interesting solutions for this pedagogical paradox has been formulated by Benner (1983, 1991; cf. also Mollenhauer 1985). This line of thought has also been developed in our faculty (Kivelä *et al.* 1996). According to this approach, the original paradox should be analysed instead of two (Bildung, Erziehung) to four principles which together make up the basic structure of the concept of pedagogical action. The first principle is originally called in German "Bildsamkeit".

It refers to the initial ability of the student to learn and develop him/herself. This property belongs naturally to every human being because it is typical to our species, but it is only a potential which can be realised in the right conditions; if those conditions are not met it can also stay unrealised or become perverted. In a pedagogical situation, the educator must develop this ability in the student because its realisation in the student is strongly dependent on the educator's attitude.

The second principle is called "Aufforderung zur Selbsttätigkeit" or demand to autonomous action. It means that educators do not only presume the existence of Bildsamkeit in the student but also act themselves in a way that later on requires the latter to realise his/her ability. This demand does not have to be a straighforward command to the student, but rather it can take place as organising his/her whole environment or certain aspects of it. The aim of this demand is not to make the student execute a certain procedure, nor to form certain habits – although these can be necessary intermediate actions – but to increase his/her ability to act rationally and autonomously in different situations.

As we can see, the two first principles represent the original paradox in quite a modified form. However they are not enough to understand education. We still ask why is this influence of an educator really needed. Why not just let the student grow and learn? Why not just have a dialogue with him/her? The explanation of this state of affairs is that the social context requires that the student acquires awareness of a kind of behaviour which he/she cannot spontaneously know. What is rational action in a certain situation depends on the whole cultural context and that is why, in education, we try to get the student to understand this context and to acquire the competences that are needed for it. We call this third principle 'contextuality'.

This third principle must be constantly revised because the prevailing cultural context is not unchanging. It is a simple fact that the future context of our children will be different from our own and we cannot even know what it will be like. The direction of development is affected by a multitude of factors. Among these factors are the actions of our students and therefore also the educational actions of ourselves. That is why we cannot just try to prepare our pupils to a certain or to an unknown future but we also have to think what kind of future is worth aspiring to. In education we must anticipate a better future, but we have to keep in mind the space for possibilities of contents and competences that will be needed when the students are improving their contexts. We have called this principle the 'Bildungs Ideal'.

These pedagogical principles have a dual role in our development of teacher education. They are the basis of the structure of the contents of the curriculum, but on the other hand they should also form the methodology of our education. According to these pedagogical ideas, we think that the teacher educator should act as a guide, who plans and arranges learning environments where the student can find and develop his/her teaching abilities and skills by discussing, studying and reflecting educational and instructional issues in groups. In these discussions it is important to compare students' own experiences with educational and didactic theories. As Kansanen (1989, 1995) has written, the theory of teacher education is based on conceptualization of action in the classroom and school and on the comparison of theoretical foundations.

Conceptualization is also a central concept in modern learning theories like constructivism. According to constructivism, learning is an active process in which a learner changes and develops his/her ideas and constructs his/her own knowledge. Therefore, the instruction should be arranged in such a way that environmental arrangements make it easy to process information, develop the structure of knowledge and remember facts and concepts. Experiential learning is useful in this aim. It has been developed for example by Lewin, Dewey and Kolb. According to Lewin, the study should include the stage of conceptualization. Conceptualization and the learning process become more effective if a tension exists between the concrete action and the analytic reflection. Theory and

practice should always be connected with each other. Experiences are in a central role also in Dewey's learning model. Analyzing phenomena is not enough, the learner should always gain experiences of the questions to be learned. Dewey stressed the significance of action and experience in his "learning by doing" method. He argued that learning experiences change thoughts, emotions and hopes into productive action. According to Kolb´s model of experiential learning, the learning process can be seen as a cycle where concrete experiences, reflective observation, abstract conceptualization and active experimentation form an actively developing process (Kolb 1984).

From the point of view of a learner, a perfect cycle means different working methods, the selection, interpretation, impression and use of information. For encouraging learners to improve their learning processes and products it is important that teachers and lecturers recognize the learning styles and strategies of their learners. Based on the Kolb's model, Kolb (1985) himself, Honey and Mumford (1986) have developed a division of learning styles. There are four learning styles: active, reflective, theoretical and pragmatical. An activist is a person who involves him/herself fully and without bias in new experiences. He/she enjoys the here and now and is happy to be dominated by immediate experiences. A reflector likes to stand back to ponder experiences and observe them from many different perspectives. He/she collects data, both first hand and from others, and prefers to think about it thoroughly before coming to any conclusions. A theorist adapts and integrates observations into complex but logically sound theories. He/she thinks problems through in a vertical, step by step, logical way. He/she assimilates separate facts into coherent theories. A pragmatist is keen on trying out ideas, theories and techniques to see if they work in practice. He/she positively searches out new ideas and takes the first opportunity to experiment with applications (Kolb 1985; Honey and Mumford 1986).

We can find many different theories of learning strategies. One very useful theory has been developed by Oxford (1990). He has divided the strategies into two main classes: direct and indirect ones. The direct strategies can be divided into memory and cognitive strategies, and the indirect strategies into metacognitive, affective and social ones. The main idea of the memory strategies is that the student binds together different kinds of facts in a form easy to recall later on. The cognitive strategies are based on cognition. The cognition includes the processes and strategies by which an individual gets information and constructs his/her own knowledge. (Oxford 1990, 40–44) The cognitive acts consist of reception, selection, evaluation, impression and representation of information (cf. Saarinen *et al.* 1989). Consequently, the cognitive strategies are training, sending and reception of information, analysis and reflection, and reconstruction of information (Oxford 1990, 45–47).

Through the metacognitive strategies, the student can observe his/her own cognition. The metacognitive strategies include, first of all, the student focusing his/her learning effort on core ideas. Secondly, he/she plans and arranges his/her learning processes in an appropriate way. Thirdly, he/she evaluates his/her own development. The affective strategies are useful in regulation of emotions, motivation and attitudes. Positive emotions and attitudes make the learning situation more pleasant and therefore learning processes become more effective. Affective strategies consist of minimizing anxiety, encouraging him/herself, and recognizing his/her own emotions. The social strategies include inquiry, co-operation and empathy. They apply to all of the group's members and not only to one student. Consequently, learning situations are to be arranged as interactional situations. The learning processes seem to be more effective if the student can use memory strategies together with metacognitive and affective strategies (Oxford 1990, 136–146). Using co-operative activities, we can learn social action and communication. In terms of a behaviouristic psychology, the pattern of social action as a whole can lie in the individual because it is carried out through implementing things to which any person can react, and because indications of these reactions to others and the person him/herself can be made by significant symbols. The reconstruction of the pattern can take place in an individual, and it takes place in the so-called conscious process in the mind (cf. Mead 1932).

The structure and the contents of the curriculum

The general theory of pedagogical action is the basis for the general structure of the curriculum of our pedagogical studies for subject teachers. This structure is best visible at the level of the modules. The studies consist of five modules, thematic wholes, which follow one after another in succession. All of these modules, except the first one, contain studies of all the three traditional main areas of teacher education: studies in general science of education, studies in subject didactics and in school practice. The students have already studied at least at the intermediate level of their subjects before they participate in pedagogical studies.

The first module consists only of a short lecture in general pedagogics and a short observation period in school. The lecture considers the structure of the concept of pedagogical action and its connection to pedagogical studies. This module is called "Orientation to the pedagogical studies of the teacher". In the second module the theme is "The growth of the human being and the adolescent". It is connected to the principle of Bildsamkeit and also to educational psychology. It contains studies of life cycle psychology, youth culture, and familiarisation of the situation of a pupil at school and different kind of pupils and their backgrounds. The third module, "Educational influence and didactics", stresses general didactics and the learning strategies of pupils. In school practice the main strategies and work patterns of a teacher are considered. The fourth module is "Contextuality of education". From this vast area we concentrate on theory of curriculum, sociology of education and educational policy. In school practice, the studies may consist of field experience or alternative courses in didactical questions. The fifth module is called "The teacher's own growth". In it, the ethical problems of a teacher's work are considered. The module also includes aims in education, development of a teacher's own work and the student teachers' own growth during pedagogical studies and later in their careers.

The period of subject didactics start at the beginning of the second module. However, in Biology and Geography subject didactics start during the first module so that the students can also study natural phenomena in the autumn. In Biology and Geography, the first and second modules consist of one credit in total. In other subjects there is no first module. In the second module, the subject didactics carries 1 credit. In all subjects, the third module consists of 2 credits, the fourth of 1 credit and the fifth one of 3 credits. The instructional groups are arranged mainly according to the grouping of school subjects. Consequently, Mathematics, Physics and Chemistry are together, Geography and Biology together, History, Religion and Psychology together, Mother Tongue and Literature together, and Languages together. Only Music is arranged so that the didactics of Music at primary level and secondary level are taught together.

The curricula of subject didactics as examples of the development process

In bridging educational theory and practice, we try to bind together special and general tasks of didactics at every level of study. Special tasks mean issues which are based on didactics of the contents of the subjects. They include planning, implementation, evaluation and development of teaching and learning processes concerning methods, material, equipment and learning environments based on the needs, values, attitudes, etc. of the pupils and society. Special tasks are bound into school and classroom practice. General tasks mean knowledge, methodological questions and the publication of knowledge. These tasks are embodied in the form of didactic research projects where the student tries to produce new information, new theories and consequently new knowledge. This means that in addition to the studies of known theories, a student or a group of students plans a reseach project from their own subject area and its didactics, collects data during the practice period in the classroom(s), reports the results and presents the report in seminar sessions. In this situation, questions like "What is truth?" and "How can we evaluate knowledge?" have to be discussed.

Different kinds of research methods become familiar during the seminar period. Thereafter, some of the students write articles on their results and findings, to be published in a newspaper, vocational magazine etc. Next we will consider the outlines of the curricula in different subjects.

Mathematics and Science

In the Finnish educational system, science consists of Physics, Chemistry, Biology and Geography. The implementation of the studies in subject didactics of Mathematics and Science is based on co-operative planning processes by lecturers and students according to scientific areas. The "new" learning environments are integrated into studies in an appropriate way. The studies also include the self evaluation of the student in the form of study logs and portfolios which they collect during the semester. A portfolio is based on set goals and it includes the student's work, for example essays, a seminar report, period and lesson plans, self-planned teaching material, handouts etc. At the end of the semester, the student of Biology and Geography also puts his/her study log and school and work certificates into the portfolio. The study log consists of the evaluations of the student teacher's teaching processes, but also our lecturers' teaching skills are evaluated. In addition, it includes the evaluation of the products of each student's own work and reflections of his/her own professional development. In the student's study log, we can find e.g. descriptions about the good features of the studying process and products. Many students also discuss answers to questions like: "How could I develop my work?", "What kind of facts, concepts, skills and attitudes did I learn during this semester?", "What more do I want to learn?" and "What kind of beliefs, emotions, observations, experiences, ideas, actions etc. did I have?" The portfolio is assessed by a lecturer alone or by a lecturer and the student together. If the lecturer evaluates the portfolio, he/she will discuss the quality of the portfolio with the student.
The studies of subject didactics are divided into four modules. Module 2 is "The growth of the human being and the adolescent". The goals in Mathematics and Science didactics are that the students familiarize themselves with human development from the point of view of a Mathematics and Science teacher. In addition, they should learn planning and implementation of teaching and learning processes based on educational theories. They should also reflect on teaching and learning theories concerning Mathematics and Science subjects and the profession of a Mathematics and Science teacher.

The content consists of planning as a pedagogical action, different kinds of learning conceptions and learning environments. It also includes curricula in one's own subjects and their development based on educational theories and practice. In this module, we also have an integrated course in Geography and Biology which is implemented together with teachers from the Normal school and the lecturers from the Biology and Geography departments. It is called "City nature". It consists of the local geographical, biological and environmental issues like climate and weather, landforms and landscapes, organisms and their environments and human impact on the environment in Oulu. The content is studied using student-centered methods, both classic ones like trips, field work, laboratory work and modern ones like drama pedagogics, earth education, confluent education and activities of values education etc. Besides action, we study educational and didactical theories and discuss their implementation in schools. Students also plan projects concerning this theme and carry them out with pupils in our training school. Afterwards, we evaluate the goals, aims, contents, methods, products and processes of these projects together. We have also written a guidebook based on material developed by the students.

In Module 3, "Educational influence and didactics", the goals and aims are that the students familiarize themselves with instruction as a tool of education. In addition, they discuss new educational views of teaching and learning processes and their guidance and develop their own

conception of learning and skills for mentoring/tutoring. The content includes questions like "What is teaching skill?", "What kind of work methods do we have?", "What is typical for good learning environments?", "What are the criteria of learning material and how can we develop material? " and "How can we evaluate learning and teaching processes and their products? "

In Module 4, "Contextuality of education", the goals and aims are that the students familiarize themselves with the school system and the profession of a teacher, the tasks of the school and the teacher in the society and the relationships between the school, home and other social institutions. In addition, the module consists of different types of curricula, their development and one's own subjects as a part of them and the cultural meaning of curricula and one's own subjects. The content consists of the integration of subjects and a world view in relation to the profession of a teacher. In this module, the students also familiarize themselves with the basic ideas of didactical research. In the subject didactics of Geography and Biology we study different kinds of trends in education (e.g. Freinet, Steiner, Freire, Montessori, Lozanov) and discuss how the ideas of these trends could be applied in our schools and in our own subjects.

In Module 5, "The teacher's own growth", the students familiarize themselves with the ethical questions of a teacher's work and the philosophical foundations for them. The educators should also help the student to develop his/her own professional identity and educational philosophy. We should also help the student to evaluate his/her own professional and personal growth during the pedagogical studies. In addition, the student has to do some educational research and to report it. In seminars, the students study presentation and chairing skills and other guiding and group processing skills which they may need in the future.

Mother Tongue and Literature

In Mother Tongue and Literature, the second module starts with group dynamic processes. The goal is to determine the common basis of the course together with the students. The content includes the curriculum of one's own subject, its basic foundations and their interpretation for planning and implementation of instruction; specifying the skill level of the pupils; familiarisation with Finnish youth culture (media culture and literature) from the point of view of subject instruction and skills for speech communication in common workshops of different languages.

At the beginning of the third module, the students choose the theme for their seminar work, plan and receive guidance for it. They discuss the relationships between learning and teaching theories and the contents of Mother Tongue and Literature. They also familiarize themselves with basic teaching skills, their construction and different kinds of work methods. In addition, they have a common workshop on reading and writing instruction.

In the fourth module, the students familiarize themselves with different kinds of learning environments. They also discuss the role of the teacher as a culture educator (e.g. one's own national culture: Kalevala – our national epic and folk tradition, media as a language). The students familiarize themselves with drama pedagogics. In addition, they plan some course entities.

In the fifth module, the main goal is to clarify the student's own conception of pedagogical values. Other goals are that the student familiarizes him/herself with the goals and aims of the different parts of Mother Tongue and Literature and their analysis. In addition, the student studies the possibilities and foundations of evaluation processes and prepares to develop his/her own expertise.

History, Religion and Psychology

The studies of didactics in History, Religion and Psychology are implemented in an integrated way. The content of the second module is that the student familiarizes him/herself with integration, planning and evaluation of instruction. He/she also discusses the topic "A teacher as a researcher" and the question "How we can take the development of the pupil into consideration?"

A part of the third module is implemented in an integrative way. It includes the issues of subject didactics, characteristics of subject didactics, work methods, preparation, usage and evaluation of instructional material, evaluation of learning and research in learning and teaching. In the fourth module, the questions of applying didactics and research are discussed. In addition the students plan their research work and receive guidance for it. In the fifth module seminars where the students present and evaluate their work are arranged.

Languages

In the subject didactics of Languages, the studies are partly integrated with Mother Tongue and Literature studies in the second module. This module consists of language and culture, learning conceptions and learning environments, common issues of language (e.g. the workshop in speech communication), the existing curriculum, development of a new curriculum in one's own subjects, planning and implementation of instruction and development of the pupil as a communicator.

The third module includes different kinds of work methods in language instruction, evaluation of one's own work, meaning centered learning environments, evaluation and development of learning material and the common workshops in languages which concern instruction in reading and writing.

In the fourth module, the content includes co-operation between different subjects, drama-pedagogical work methods, the language teacher as an educator in the area of culture, learning/teaching through foreign languages, multicultural learning environments and the common workshop of languages about reading and writing instruction. In the fifth module, the main goal is to clarify one's own values conceptions.

Music

In the second module of Music, the student discusses the meaning and possibilities of music in supporting the growth of an individual. The student also familiarizes him/herself with the central goals, content, methods, materials and evaluation of music instruction in the comprehensive school. In addition, he/she should reflect on the possibilities of music integrating with art education (different kinds of subjects, themes and topics).

In the third module, the main goal is that the student discusses the role of the music teacher as a tutor/mentor. In addition, the student familiarizes him/herself with the goals and aims, content, methods, materials and evaluation in instruction at the secondary level. He/she also studies the basic foundations of the curriculum and plans periods of instruction.

In the fourth module, the main goals consist of the professional development of a music teacher based on the scientific world view. The student also familiarizes him/herself with research in music education, the research in subject didactics and development of his/her own work through scientific knowledge.

In the fifth module, the main goal is that the student familiarizes him/herself with the concept of "the music teacher as a researcher" and writes, reports and evaluates his/her own paper.

Conclusion

From our initial experience, we think that this structural reform has helped students to see their studies as a whole, where theoretical and practical, general and specialised knowledge can be integrated.

We have noticed that discussions on instructional issues, gaining familiarity with 'new' learning environments and basic questions of subject didactic research as a part of one's own subject(s), has helped students to understand how the theory of subject didactics can be applied in the teacher's work. A seminar report on a practical issue of subject didactics chosen by the student him/herself has been similarly effective.

However, the reform is not finished yet. In future, we should emphasize subjects more and develop subject didactics together with subject departments and schools. We also need more research and development on general questions of pedagogics and didactics.

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