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Kompetenzmodellierung

Zwischenbilanz des DFG-Schwerpunktprogramms und Perspektiven des Forschungsansatzes

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Benő Csapó

Goals of Learning and the Organization of Knowledge

1. Introduction

Since the beginning of formal schooling, there has been a perennial search for *worthwhile knowledge*. Philosophers who have been posing similar questions on the issue mostly deal with objective knowledge,[1] whereas educators are interested in knowledge possessed by individuals. More specifically, educators' interest is in teaching and learning processes that result in worthwhile knowledge. One of the most recent candidates for this status is *competence*. Although there is no consensual understanding of the term, it has entered the discourse of policy documents. In this paper I outline a framework for interpreting the concept of competence. In so doing I offer a systematic way for comparing educational standards, curricula and assessment practices that will help us to better identify the goals of learning and design curricula.

For more than two millennia, there have been three main types of answers to the question „Why do children have to attend school?": (1) Transmitting knowledge accumulated by scientific inquiry has been a goal since at least Aristotle's time. (2) Cultivating children's developing minds emerged as a goal in ancient times as well, and since then has disappeared and re-emerged in the history of education. (3) Seneca's aphorism *Non scolae, sed vitae discimus* indicates that a social aspect, the external usefulness of knowledge mastered at school, has also been around for quite some time. Over the past centuries, attention has shifted between these three aspects of schooling, with one of them dominating from time to time. The pendulum seems to swing not only between the internal (focusing on children's abilities) and external (content of teaching) poles, but also along a triangle, set by the internal/psychological, content/disciplinary and social needs/application points.

In this paper I argue that these same three aspects identified in the course of the history of education still play a key role, and propose a framework that helps us to better identify goals of learning and contributes to more conscious curriculum design. Previous approaches were often dominated by one of these aspects. I argue that we have to keep all three of them in mind when setting standards, developing curricula and devising assessment frameworks.

Knowledge and *learning* are closely interlinked key concepts of educational science: The way children learn determines the type of resulting knowledge. In educational contexts, the two therefore cannot be conceptualized independently of each other. Conse-

1 Popper (1972) gave this title to his collection of essays, but subjective knowledge is no less interesting from a philosopher's perspective; see Polanyi (1958).

quently, revising these concepts should be perceived as parallel or rather integrated processes. Recent developments in society and economy, greater expectations concerning trained work force, expanding opportunities of learning and especially the accelerating speed of changes have prompted a continuous effort to define not only the knowledge needed by modern societies but also optimal learning and teaching processes. Such a reconceptualizing course of action is clearly indicated by the large number of recent publications on the subject. *Review of Research in Education* devoted its 2006 volume[2] to revisiting the concept of learning and its 2008 volume[3] to the concept of knowledge. The collection of essays edited by Benavot/Braslavsky (2006) examines new approaches to school knowledge and curriculum development from a broader social and global perspective that goes beyond the cognitive point of view.

One aspect of the new approach, as seen in the widespread use of the expression ‚forms of knowledge', indicates that a more differentiated view of knowledge as a product of learning is needed. We may assume that different goals require different methods of learning (and teaching) and that these processes result in different types of knowledge. In previous studies (Csapó 2004) I outlined a model representing various types of knowledge produced by schooling, as a function of pedagogical culture and of the methods of implementing curriculum contents. This model, based on the theoretical generalization of the findings of a series of empirical research projects (Csapó 2002), provided a framework t oaccount for the differences in the quality of knowledge.[4]

In this paper I aim to show how a deeper understanding of learning and knowledge organization can contribute to designing curricula, preparing teaching materials and devising assessment standards that promote both students' development and their social needs more efficiently. I argue that three dimensions of the goals of learning have to be considered and that schooling cannot become more effective unless all three are viewed together. Each of the three dimensions can be targeted as a main goal in itself or can be seen as a prerequisite to or a means of achieving goals in the other two dimensions.

2. Sources of Educational Goals and the Dimensions of Learning

Most of the arguments regarding the goals of education fall under one of the following three approaches: (1) The scientific accumulation of knowledge is accelerating; therefore, an increasing amount of knowledge must be acquired at school. (2) Learning is about cultivating students' intellect and improving their abilities. (3) School must prepare its students for life and provide them with knowledge they can apply beyond school.

2 Rethinking Learning: What Counts as Learning and What Learning Counts.

3 What Counts as Knowledge in Educational Settings: Disciplinary Knowledge, Assessment and Curriculum.

4 For a summary of these projects, see Csapó 2007.

These three approaches are deeply rooted i nEuropean culture in general and European education in particular. When setting learning goals we have to consider three corresponding aspects or dimensions. First, there is the disciplinary or content dimension. An important source for setting goals is systematically organized external knowledge, accumulated and offered by the arts and scientific disciplines. Next, there is the social and cultural dimension, defined by the context for applying knowledge and by the expectations students need to know and be able to fulfill in order to become active and successful members of a given society. Finally, there is the internal, psychological dimension: how human intellect acquires, processes and applies knowledge, and how education should shape the related capabilities. These three aspects, however, point to three dimensions, a sillustrated in Figure 1.

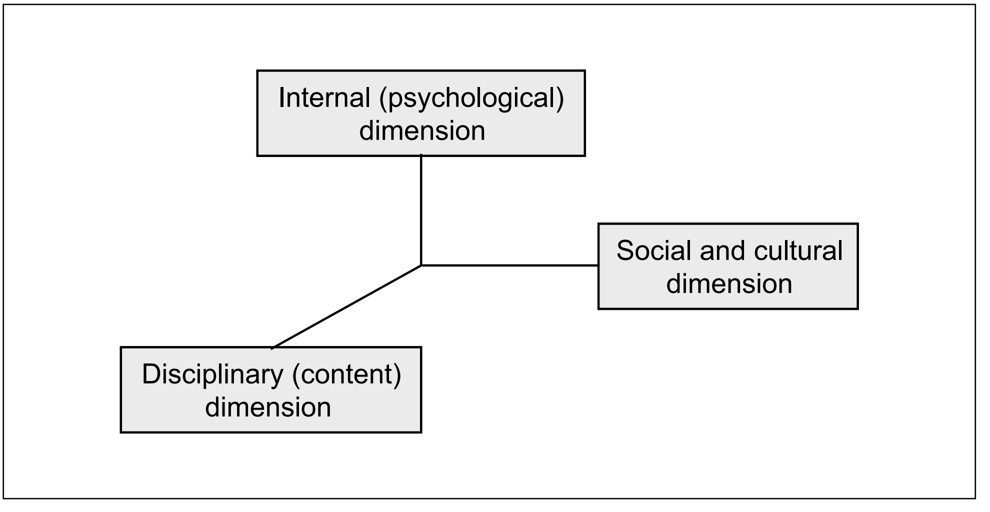

Fig. 1: Dimensions of the goals o flearning

A similar three-dimensional model can be applied to knowledge acquired through learning. When inquiries are made about both the integrating principles that incorporate the individual elements of knowledge into an operational system and the justification of the presumption that the acquired knowledge will last, we arrive at the very same three-dimensional scheme (Csapó 2004). In a similar vein, when making efforts to find the sources for setting and accomplishing goals, we also find three categories (i.e., knowledge accumulated by the arts and sciences, results of psychological and methodological research and social needs and expectations). Table 1 provides a summary of this scheme.

Assessment frameworks may also assume three approaches. Discipline-dominated assessments measure knowledge in the same (disciplinary) context in which they are mastered. Assessments focusing on psychological attributes such as general abilities, problem solving or creativity may be free of any specific content. Finally, assessments evaluating how knowledge is applied in a social context have to deal with transferable knowledge and competencies.

Characteristics	**Disciplinary, content-based**	**Internal, psychological**	**Social, cultural, application**
Goals of learning	Acquisition of canonized content (objective, scientific knowledge)	Development of cognitive functions and intellectual abilities	Acquisition of sociocultural codes and modes of behavior and action, preparing the individual for integration into society
Emerging knowledge	Expertise, domain specific skills	Thinking skills, improved general abilities	Literacy, flexible and expandable knowledge applicable in a broad range of contexts
Sources for designing standards, curricula, textbooks, learning materials	A systematic body of knowledge of the arts and sciences	Results of psychological and educational research	Analysis of social needs and contexts of knowledge and skills application
Assessment	Same context as learning	Focus on structures; content plays a secondary role	Transfer from school to everyday context

Tab. 1: Dimensions and structure of knowledge

When examining the individual columns of the table and the resources available for improving teaching and learning in the particular dimension, large discrepancies are found. The following sections examine the most important features of these three dimensions.

3. Disciplinary, Content-Based Dimension of Learning

In early times, schooling focused on the acquisition of knowledge in philosophy, the humanities, and the arts. Then, spectacular developments in the natural sciences demanded their curricular inclusion, leading to the humanities/science dichotomy. In the last century, procedures for the systematic planning of school curriculum contents were also established, and it is no coincidence that the systematic, canonized body of knowledge accumulated by the sciences (and, to a lesser extent, by the arts) became its primary source.

The disciplinary approach has affected the methodology of teaching and learning substantially. Knowledge is rooted in science, with teachers and textbooks as transmitters. According to the simplified approach that neglects the other two dimensions, the teacher ‚delivers' the teaching material, which the student learns. The role model for the students is a researcher or teacher of the given discipline. The school transmits the mathematics of mathematicians, the physics of physicists and the history of historians. Developing an understanding of the relationships offered by the content occurs in the specific context of the given school subject. Gardner (1991) calls this kind of comprehension *disciplinary understanding*. Concepts are anchored in results of scientific research and are shaped by scientific definitions. Learning contents is organized in the way the given discipline structures its knowledge, and the process of teaching follows this logical order. Dealing with formulas for mathematics, physics and chemistry; memorizing in the simplest case; or transforming and linking the formulas take place by mastering a body of disciplinary knowledge.

Some school systems, including many European and Asian ones, have achieved remarkable results in transmitting disciplinary knowledge. Schools of this kind nurture ‚little scientists', who can turn into great researchers when they grow up. This approach seems acceptable for those few who strive to continue their studies at universities in the given discipline and later become experts in the field, earning their living as such. However, without investing effort into developing general intellectual skills (for which science as a learning content offers excellent opportunities), the disciplinary approach in itself is not enough to educate inventive, creative scientists. At the same time, those who do not want to pursue a career related to that particular discipline in research, development or education will hardly benefit from discipline-oriented learning. Research on conceptual change and science misconception has also shown that students' scientific knowledge is often isolated from everyday life and that students tend to apply their naive models generalized from personal experiences rather than their school-created scientific knowledge to interpret phenomena.

Traditional discipline-oriented teaching methodology focuses on transmitting content defined as valuable by the scientific community. This viewpoint is further reinforced in many teacher training systems by allocating instructors' job statuses who teach discipline specific teaching methods (*Fachdidaktik* in Germany) at disciplinary departments. Influential academic communities in this area have been formed, with strong professional associations and journals. Discipline-related teaching methodology journals (especially those of the natural sciences) adopted the norms of scientific publications at an early stage and compiled a considerable amount of scientifically established knowledge on the teaching of the particular disciplines at school.[5]

The disciplinary approach to learning is in a very strong position, having at least a half-century advantage over the other two dimensions in terms of its traditions and infrastructure. Its position is further strengthened by the fact that nearly the entire community of academics identifies with the very same approach and uses it when educating their successors: academics, specialists, experts, or the gifted in general.

5 The fact that the Web of Knowledge (formerly Thomson Scientific) includes these types of journals in the *Science Citation Index* (and not in the *Social Science Citation Index*) also seems to support this statement.

Several trends in psychology and education have contributed to strengthening this approach, the most prominent being the early phase of cognitive psychology,[6] which regarded genuine knowledge primarily as expertise.[7] The development of expertise is studied by comparing the novice and the expert, and progress is defined in terms of the number and differentiation of schemata used in specific contexts. Fully developed expertise comprises thousands of specific schemata, which, once learned, can be used effectively. However, this entails learning a huge amount of facts and data and mastering schemata applicable in the appropriate contexts. Such knowledge is generally reproductive and used under circumstances similar to its acquisition. Both the expert and expertise are defined by the subject, without allowing for transferring knowledge to novel or distant areas. Here, problem-solving is seen as the application of knowledge to (relatively) new situations. In this model, experts are engaged in much less thinking than is usually assumed: they know the answer practically off-hand. If they do think, it is not computation-like logical operation. Rather, it is a search among familiar schemata, the matching of a ready-made solution with the situation.

Despite all its shortcomings, disciplinary learning has yielded much that is valuable and should be preserved. However, it needs to be revisited from time to time (see Ford/Forman 2006; Duschl 2008). The discipline-based approach has little to say about how learners actually reason. Although the study of knowledge as expertise assumes that experts reason when they process information, other paradigms have developed more sophisticated models of how reasoning takes place.

4. Internal, Psychological Dimensions of Learning

References to psychological considerations preceded the establishment of the science of psychology. One of Greek philosophy's major missions was to cultivate the intellect. The virtues or wisdom mentioned by Aristotle do not imply the acquisition of an external entity but rather the development of an internal quality.

No sooner was formal education born than the need to develop thinking, generally meant as logical thinking, was manifested. For a long time, it was thought that it could be fostered by learning mathematics and the grammatical structures of languages. The assumption behind the endless practice of certain grammatical and logical puzzles was that they made students smarter, but without a clear vision of how schooled minds differed from unschooled ones, these efforts produced little success.

As soon as scientific tools for studying the human intellect came into being and psychometrics presented techniques for measuring intelligence, the urge to develop the in-

6 As a prototype of the works on this issue from the early stage of cognitive psychology, see Simon's 1979 study. For later conceptualizations, see Ericsson/Smith 1991.

7 The first and major part of the book ‚How People Learn' – and its extension to mathematics, sciences and history – provides a good description of this approach (Bransford/Brown/Cocking 2000).

tellect based on this new scientific approach accordingly emerged. The question arose to what extent intelligence or any of its components can be learned and taught. Factor analytic studies provided the basis for models of the structure of human intellect and identified the most important intellectual abilities. However, the concept of intelligence became the subject of ideological and political debates; as a result, it fell into disrepute for some time.

Nevertheless, several experiments attempted to improve thinking skills, general cognitive abilities[8] or even intelligence, although most of them adopted the so-called direct approach and yielded controversial results (see Blagg 1991). Failure may be partly due to the fact that intelligence is a complex construct and its measurable manifestations and effective functioning imply the combination of a number of specific abilities in a concerted and coordinated effort. Moreover, the notion of intelligence – particularly in association with hereditariness – became discredited in the public eye, thwarting informed discussions of it in the context of school education.

Success is more probable in the case of abilities whose structures readily lend themselves to study and description, thereby simplifying the identification of appropriate developmental tasks. However, such endeavors rarely transcended a few experiments of limited scope, with two factors having prevented the expected improvements from becoming fully fledged. On the one hand, no development is possible without some content, and neglecting the curricular, disciplinary content proved to be a dead end. On the other hand, the abilities that these projects aimed to develop are much more difficult to identify and are less understood than the widely known disciplinary contents or the knowledge gained through learning them.

The development of general abilities resulting from learning is more difficult to observe, and the process is more difficult to monitor. Therefore, approaches[9] that use restructured curricular materials to improve thinking processes that can be more easily identified are more successful and report more lasting effects. For example, Piaget offered a framework for describing the developing mind; furthermore, mathematics and science (and some other school subjects) provide well-structured (or restructurable) materials to practice reasoning skills (Adey 1999; Shayer/Adey 2002).

Mathematics and reading enjoy a special status among school subjects, given that learning them is so deeply embedded in the psychological apparatus of humans. Therefore, applying methods in teaching mathematics and reading that are based on the results of psychological research are the best tools for facilitating the development of students' minds (Nunes/Bryant 1996, 2009).

In general, there is a clear shift in cognitive training from direct methods using abstract materials towards embedded methods (see Csapó 1999) that use the content of

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8 Costa (1991) presents a large number of programs from the U.S.A. aimed at teaching thinking, most of which assume the direct approach.

9 Such programs are discussed in the books edited by Hamers/Overtoom (1997) and Hamers/van Luit/Csapó (1999).

teaching to stimulate intellectual development.[10] This approach is more compatible with existing schooling practices, because it considers the goals mentioned in the previous section acceptable and contents of materials offered by the disciplines as more or less given. However, there are large differences between the two approaches. The first one regards transmitting disciplinary materials as a primary source for planning instruction and aims to produce expertise based on this knowledge before seeking psychological theories and scientific evidence that support this goal. The approach presented in this section considers development of human capabilities as a primary goal and looks for disciplinary content and methods of teaching that best serve this end (see also Kuhn 2005).

A new category of scientific knowledge on the psychological dimension of learning has proliferated in the last few decades. One of the most dynamic fields of modern sciences is brain research or cognitive neuroscience in general, which studies the biological apparatus of information processing. The heightened interest in this field gave momentum to several international projects and syntheses (OECD 2007; Geake 2004; Goswami 2004; Stern et al. 2005). Although cognitive neuroscience obviously cannot accomplish the universal task of laying the scientific groundwork for learning (Bruer 1997), its advances have had a direct impact on recent developments in formal education in several areas. The *How people learn* framework (Bransford/Brown/Cocking 2000) also considers brain research as a founding discipline for education in general; however, results of cognitive neuroscience in its present state are most helpful in learning settings that are characterized by the rapid development of the nervous system (in pre-school and early school years) or when development significantly diverges from the average. These findings can also be highly relevant in cases where the knowledge to be acquired is more closely tied to the biological apparatus or is determined by the other two (the disciplinary and the cultural) dimensions to a lesser degree: early reading and mathematics are good examples here.

The findings of brain research brought intelligence and the issue of general abilities to the foreground once again. If it is true that the human brain is plastic and can be transformed by appropriate stimuli and learning, then education cannot afford to ignore the implications. Therefore, opportunities of learning that develop plastic general abilities have to be assigned a more central role (Adey et al. 2007).

5. Social Needs and Application-Oriented Dimension of Learning Goals

The third main aspect of learning is the application dimension: Students are expected to acquire knowledge that is socially valid, which helps them to be successful in their private and professional life. Traditionally, schooling was expected to fulfill these aims.

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10 This shift is clearly demonstrated by Klauer's work on training inductive reasoning. This model of inductive reasoning, first implemented in the form of three sets of training instruments using abstract materials, later served as a theoretical framework for several content-based training experiments in a number of school subjects (for an overview, see e.g., Klauer 2001; Klauer/Phye 2008).

Today, the fact that a great deal of learning takes place outside of the school walls makes it tempting to challenge this notion. However, learning that occurs outside the school usually takes place in the same context in which the knowledge needs to be utilized; consequently, application of the result of this kind of learning is natural. The burden is hence on formal education and educational researchers to find ways of teaching and learning when the context of the future application of the outcomes of learning is increasingly unknown.

Challenges and unsolved problems are most apparent in this dimension. Although it is obvious that schooling has to prepare students for life, there is little scientific knowledge of how this preparation should be best done. There are established methods to map disciplinary knowledge onto school curricula, and there are the experts as models of successful learners – models whom students may be expected to follow when aiming to master disciplinary knowledge. A growing body of psychological knowledge supports refining the goals of improving general abilities. However, there are no generally accepted scientific methods to identify social needs and expectations concerning useful, valid and applicable knowledge (Duschl 2008).

Educational systems face growing pressure to prepare students for life, but curriculum developers and assessment specialists find little research that indicates how this can be done. Several research paradigms did, however, examine the relationships between traditional schooling that focuses on subject matter knowledge and the requirements of the outside world, – in particular the discrepancy between learning that takes place at school and outside of it and between knowledge mastered at school and knowledge useful in life. The inconsistencies became most apparent in mathematics: Students were hardly able to utilize the de-contextualized, abstract knowledge in realistic contexts. The comparison of school mathematics and ‚street mathematics‘ revealed that transfer is not automatic in the other direction either: Children successful in practical numerical operations may fail at school (Nunes/Carraher/Schliemann 1993). Several approaches tried to bridge the gap; these include *realistic mathematical modeling*[11] and re-conceptualization of the role of real-world problems in mathematics education (Verschaffel/Greer/De Corte 2000). In some disciplines, economic pressure accelerates the identification of such skills and knowledge. The profound change in the curricula for foreign languages from grammatical and cultural studies to communication was a result of pressure from stakeholders.

Teaching abstract science contents in some modern areas of physics and chemistry has generated similar problems; in reaction it was often proposed that students be taught something ‚practical‘, meaning directly applicable in real life. A broad range of such practice-oriented approaches have appeared in the past decades, from ‚home-science‘, ‚kitchen science‘, and ‚hands-on science‘ to complex projects and the application of principles of problem-based learning. Such methods may have great motivating power and help form students‘ attitudes towards learning science. They are also great tools for integrating and structuring students‘ knowledge. But if they abandon the principles of

11 This approach is most prominently represented by the work of the Freudenthal Institute.

scientific reasoning and the resulting knowledge is bound to a narrow context lacking transferability, they are just as inert and ineffective as rote learning.

Exploring the ways in which schools can prepare their students for meeting the expectations of society and the economic environment has also become a central issue in contemporary large-scale assessment projects. The most influential analysis of this kind is taking place within the framework of the OECD PISA surveys. PISA broke with the practice of disciplinary, curriculum-based assessment and relies on the knowledge needs of modern society when defining the themes of its assessments. The theoretical framework for the surveys (OECD 2000, 2003, 2006) describes the body of knowledge fifteen-year-olds need in modern societies in order to be able to participate in social processes, to create a balanced way of living as well as to develop themselves. When this new concept of knowledge was outlined, literacy served as a point of departure. The earlier role played by literacy in the narrow sense of the word (i.e., reading and writing) was replaced by a body of broadly based knowledge applicable in various situations. The broadening of the term *literacy* generated concepts such as reading literacy, scientific literacy and mathematical literacy. In our interpretation, the literacy concept of the PISA frameworks points to this third dimension, and in this way, measures an important aspect of students' knowledge that had not received enough attention before.[12]

The findings of surveys[13] show that solving practical tasks different from the ones that are a given at school presents considerable difficulties for students, even if they possess the necessary skills. Studies have revealed that the transfer of knowledge does not come automatically and that further learning and development are necessary to facilitate the application and transfer of acquired knowledge to new contexts (Bransford/Schwartz 1999).

Obviously, one of the principal goals of schooling is to create knowledge applicable to practical real-life situations. In theory, there seem to be two paths to achieving this. One is to introduce radical changes in the content of education: Disciplinary knowledge has to be superseded by practical knowledge that is directly applicable in everyday life. Simple as it may seem, it is easy to see that doing so would not engender the desired results. First, the environment in which acquired knowledge is to be employed can be unpredictable and may change profoundly several times during the lifespan of the user of this knowledge. Second, social needs regarding applicable knowledge change very rapidly. Third, ‚common' everyday applied knowledge does not lend itself as readily as a scientific body of knowledge to being organized into a clear-cut system or into basic principles that are generally valid. This approach alone leads nowhere.

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12 A similar, albeit less explicit three-dimensional thinking can be identified in the way Klieme/Hartig/Rauch (2008) introduce the essence of the PISA approach. „They neither restricted educational assessment to knowledge and skills within a few school subjects, nor referred to psychological theories. Instead, they took a functional view, asking whether young adults are prepared to cope with the demands and challenges of their future life" (p. 8).

13 In addition to PISA, several in-depth Hungarian research programs have highlighted the difficulties of knowledge application in realistic contexts (Csapó 1998, 2002).

The other road to take is a more effective way of imparting scientific knowledge and reinforcing mechanisms that foster understanding and thus transfer more efficiently. It leads us to a comprehensive approach to the three dimensions of learning, that is, to the integration of the development of thinking and abilities and instruction in curriculum contents in order to create knowledge that is more deeply understood and can be more extensively applied. PISA has underpinned this trend by the inclusion of problem solving in addition to the three core domains in its 2003 survey (OECD 2004).

The OECD PISA project reaches beyond establishing a new concept of knowledge. It also sheds new light on learning itself. The first analysis of this kind, incorporated into the 2000 survey, formulated the question whether the learning methods that students in the participating countries adopt to prepare for the ‚real world‘ can meet the expectations raised by the modern age. Do they process through active reasoning what they learn and strive to understand it or do they aim only for rote learning? Have they acquired self-regulated learning, which enables them to organize their own learning processes effectively and to become high-achieving learners once they no longer have the external control of the school to rely on (Artelt et al. 2003)? Results showed significant differences between learners from the participating countries.[14]

6. Efforts Aiming to Connect Multiple Goals and the Concept of Competence

Although all three dimensions discussed in the previous sections can be traced back to ancient times as goals of education, combining them is a relatively new phenomenon. Expectations concerning education in the 21st century may be so radically different from those of the previous centuries that they call for an even closer integration of these dimensions. Two aspects underpin such a need: (1) Knowledge has never played such a decisive role in the lives of such a great proportion of people. (2) The pace of changes to the social and economic environment may be faster than the developmental changes in an individual’s life; therefore, knowledge necessary throughout the lifespan has never been so difficult to foresee.

Several theoretical frameworks have been proposed and a number of empirical studies have been proving that learning that includes deep reasoning may be the best tool both for developing students’ minds and for constructing and retaining a well-organized body of content knowledge. Complex methods integrating an increasing number of functions employ well-structured contents of learning in order to develop skills and abilities. Research and development projects and experiments have shown that well-structured instruction enriched with relevant practice fosters not only the acquisition of the subject matter but also develops intellectual abilities effectively. Ausubel (2000) proposes active, *meaningful* learning; others (e.g., Darling-Hammond et al. 2008) focus

14 Hungarian students ranked relatively low. The predominance of rote learning has been confirmed by a similar survey on several age groups (Németh/Habók 2006).

on understanding or even multiple understanding.[15] These approaches integrate two dimensions (content and psychological) of learning. I suggest going on to integrate the third dimension as well and contend that meaningful learning – that is, learning with understanding – is also the best way to increase the applicability and transferability of knowledge.

Thus, I have arrived at the concept of competence; recently, it has been one of the most frequently used and the most controversial constructs at the same time. Extensive theoretical conceptualizing efforts (e.g., Rychen/Salganik 2001, 2003; Hartig/Klieme 2007; Koeppen et al. 2008), political documents[16] and large-scale empirical projects (Klieme/Leutner 2006; Hartig/Klieme/Leutner 2008) have been using this concept.

Seeing this recent vast interest in competence, we may ask the question whether competence is a new, recently discovered psychological phenomenon or if it is the quintessence of „good knowledge", the form of knowledge that educators and educational researchers have been looking for. As several studies have pointed out (e.g., Weinert 2001; Klieme/Hartig/Rauch 2008), the term *competence* has been used in a great number of senses, quite often as a synonym for several other terms. Not surprisingly, interpretations may be easily found that point to one of the dimensions described earlier. For example, Chomsky's (1968) original concept of competence emphasizes its innate character, fitting into the psychological dimension. In the PISA terminology, *competence* and *literacy* are often used interchangeably, indicating that in the PISA interpretation, competence points to the application dimension as identical with applicable, socially valid and valuable knowledge. Other interpretations (see examples in Weinert 2001) relate competence to specific skills and knowledge of a profession, using competence as a synonym for expertise or expert knowledge (*Fachkompetenz*).

In educational contexts, competencies are often defined as complex ability constructs contextualized and usable in relevant situations (Klieme/Hartig 2007; Klieme/Hartig/Rauch 2008). In this approach, each dimension described earlier is present. Therefore, in the framework presented in this paper, I suggest considering competencies not as identical with one of the dimensions, but as a harmonious composition of all three.

Accepting the interpretation that competencies are complex constructs and regarding their development as the ultimate aim of instruction does not mean that each particular educational process always has to deal with competencies. Recent proliferation o fthe term may imply an interpretation that no other constructs play an important role in learning. I do not share such a view but propose a more differentiated approach, where several combinations of the described dimensions result in the desired outcomes. For example, in early childhood the psychological dimension may dominate: Education should stimulate the developing mind and this aspect should determine the selection of

15 Gardner (1991) distinguishes several kinds of understandings, while Bereiter (2002) elaborates an even broader range of the forms of understanding.

16 See the eight domains of key competencies defined by the European Reference Framework (European Commission 2004).

the content of learning. Later, especially when preparing for a profession, learning may be directed by the structure of knowledge organized by the logic of a given discipline or trade. Application plays a significant role in both cases, aiming for a broader transfer in the first case and a narrower one in the latter.

Authentic summative assessment cannot take place without considering competencies in their natural complexity. I tcannot happen without (1) the application of knowledge in new contexts that require (2) highly developed general information processing skills and thinking abilities, and, of course, (3) well-structured disciplinary knowledge that is supposed to be applied. PISA took this global approach when introducing the concept of literacy and has been focusing on its assessment ever since. However, there are still unrealized potentials in this approach, given that in modern societies, knowledge learned earlier is often applied in other learning situations. For example, application of mathematics knowledge may happen in science. Therefore, not only real-life, meaning ‚everyday‘ situations can be considered authentic.

Formative or diagnostic assessment may require a different approach, focusing on one of the dimensions separately from the others. Just as a diagnosis in the medical practice assumes knowledge of the anatomy of the diagnosed body, diagnostic assessment assumes knowledge of the structure of the assessed competencies. Diagnostic assessments and student-level monitoring systems may focus on one of the dimensions in order to identify specific developmental abnormalities.

Competencies are considered dominantly cognitive constructs. At the same time, it has become increasingly clear that the processes determining the efficiency of formal learning cannot be understood by paying attention to cognitive factors alone, without considering the social environment where learning occurs and the non-cognitive psychological dimension. A few decades after the cognitive revolution, relying heavily on its advances and new research methods, research into non-cognitive factors took off, so much so that nowadays we are witnesses to an affective and sociocultural revolution. A deeper understanding of motivation, self-concept and attitudes to learning, various subjects and curriculum content has effected changes in instructional practice and contributed to improving pedagogical culture. Clarifying the interactions between competencies and the affective domain offers further potential for psychological and educational research.

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