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Middle-School Education in Germany

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Abstract:

Germany's middle school system is characterized through a tripartite stratification. These three kinds of school were founded during the 18th and 19th centuries according to an earlier tripartite idea of abilities: manual, technical and intellectual. Sorting into "Hauptschule", "Realschule" and "Gymnasium" takes place at the end of grade 4 and it is based on teachers' recommendations. Comparisons of these recommendations with student achievements measured in standardized tests and inquiries of students' socio-economic background show a strong social bias. Teacher education for middle school mainly happens as part of a shorter and less subject-matter focused elementary program or as part of a longer and more subject-matter focused secondary program. Programs specialized on middle school education are rare. After important progress in research on the achievement of middle school students, the focus of research has recently changed towards teacher education for middle school. It turns out that professional competencies of middle school

teachers heavily depend on the kind of teacher education they receive. Current reform initiatives focus mainly on the area of higher education.

1. CONTEXTUAL NARRATIVE

Germany is a federal republic with high autonomy of its 16 states when it comes to educational decisions. According to the Freedom House Index (2004), its democracy belongs to the highest developed political systems in the world. With 82 million inhabitants, the country has the largest population of all member states of the European Union. 10 million inhabitants (i.e. about 12% of the population) are immigrants, mainly from Turkey and Russia. Germany is located in Central Europe and surrounded by Poland and the Czech Republic in the East, by Austria and Switzerland in the South, by France, Belgium and the Netherlands in the West, and by the Atlantic Ocean, Denmark and the Baltic Sea in the North.

Germany's Gross Domestic Product (GDP) of 3 trillion US-Dollar is the third largest in the world (source?). Only the United States and Japan have a larger GDP. The country's relatively high developmental status is also shown in United Nations' ranking of human development. The Human Development Index (HDI) summarizes several indices of health conditions, educational features and economic status in one measure. Within a range from 0.336 (Sierra Leone) to 0.968 (Norway) Germany is placed at the upper end with an HDI of 0.935 (United Nations, 2005).

Individual freedom and economic competition in a liberal market system can be regarded as main cultural values (Landes 1999, 192ff; Inglehart 1997, 324ff). These values are mirrored on Hofstede's (2001) and Triandis' (1995) individualism-collectivism scales on which Germans show a very high level of individual beliefs. From a religious point of view a three-folded grouping can be noticed. In Southern and Western Germany, Catholics have the majority; overall they represent about 30% of the German inhabitants (source?). In Northern and Eastern Germany,

Protestants have the majority; overall they represent 30% of the inhabitants as well. Another 30% of Germans are not members of a church; this applies especially to Eastern Germany and big cities. 4% of the inhabitants belong to the Islam.

2. HISTORY AND ORGANIZATION OF SCHOOLING FOR YOUNG ADOLSCENTS

Historical Background

Due to federalism as early as in the nineteenth century there were regional differences in the development of the educational system. Also in the twentieth century the authority of the federal states regarding educational issues has been untouched which was fostered by the occurrence of the Nazism. Between 1933 and 1945 the political influence of the Nazi state on the educational system was strong (Keim, 1995; Dithmar, 2001). After an examination of these dynamics, one of the most important societal agreements after 1945 was to never again allow dictatorial influence on educational questions. For Western Germany, this implied – among other changes – the formation of a Federal Republic (FRG) in which the rights of each federal state are extensive, especially regarding educational policy, to prevent strong central power. Thus, legislation for education devolves to the 16 federal states. In 1948, the *Ständige Konferenz der Kultusminister der Länder* (KMK, Conference of Ministers for Education and Cultural Affairs) was established to coordinate educational issues between the federal states. Since then, the KMK has served as a forum of permanent cooperation. Its resolutions only have the status of recommendations though until they are enacted by the parliaments of the federal states and implemented into regulations on the level of the federal states.

The basic structure of the present German school system evolved between the 15th and the 18th century although first schools on German territory had been founded as early as around 100

AD as part of the Roman Empire (Blömeke, Herzig & Tulodziecki, 2007). As part of christianization schools had been founded from the 8th century on but they mainly served religious purposes through the training of priests. The language of instruction in these early schools was Latin. The economic development during the late Middle Age showed a need of well-trained workers for craft and trade professions then, especially in the cities. So, during the 15th century for the first time larger numbers of schools were founded. These focused on preparation for vocation and served mainly commercial purposes; their language of instruction was German. Two centuries later, the building of German nations with combined political and religious leadership required an education of the respective state populations according to the leaders' values. A comprehensive school system with schools not only in cities but also in rural areas was founded, followed by compulsory education from the 18th century on.

For young adolescents, stratification is the most important feature of this school system. On the middle school level, in the beginning two (“Volksschule”/lower school system and “Gymnasium”/higher school system), from the end of the 19th century on three kinds of schools (“Volksschule”, “Realschule” and “Gymnasium”) have been existing in parallel to each other. This stratification follows a “theory” according to which different kinds of natural talent exist (manual, technical and intellectual) that must be developed in different kinds of schools (Deutscher Ausschuss für das Erziehungs- und Bildungswesen, 1966; Spranger, 1974). The stratified school system was meant to lead to separate levels within society (working class, middle class and upper class). Table 1 shows details of the stratification as it was in place in mid 19th century.

Table 1: Characteristics of the stratified school system in Germany in mid 19th century (cf. Diederich & Tenorth, 1997)

	“Volksschule”/ Lower School System	“Gymnasium”/ Higher School System
Structure	6 years elementary school	3 years primary school, followed by 9 years Gymnasium
Funding	Local authorities, no school fees (except for teaching materials)	Churches, state; school fees; payment for teaching materials and housing
Curriculum	Religion, basic cultural techniques (reading, writing, math)	Subject matter, preparation for university
Teachers	Low-paid staff, hired by local authorities, generalists	Subject specialists, senior civil servants
Teacher Training	Secondary level (after elementary school)	University based (tertiary level)
Graduation	None (school is left with only a report card, without the right to go on somewhere else)	After grade 10 military service reduced to one year, start as an officer candidate; after grade 12 high-school exit exam with the right to go on at university

Politically, the stratification of the German school system has been subject to highly controversial clashes with ideological connotations throughout the 19th and the 20th century. However, the forces of persistence have been strong enough to maintain this structure even after it was faced with empirical findings disproving the basic theory of talent during the 20th century (Roth, 1969). After the Second World War, attempts were made to give up the stratified school system; in Western Germany the fundamental characteristics of the educational systems in the federal states as they had been in place during the 1920s were reinstated though – including the tripartite system on the middle school level (Führ, 1998). One reason for this was that stratification was considered a response to the instalment of a comprehensive school model from grades 1 through 9 in Eastern Germany. Since the two German countries represented the frontline countries of the Western bloc and the Eastern bloc, any decision in Western Germany was highly political and its repercussion upon the Western bloc was always the subject of critical discussion. Against this

background, it has been almost impossible to reform the education system for a long time because any proposal was compared either to Nazism or to the politics in the German Democratic Republic (GDR).

Closely linked to the development of the school system was the development of teacher education. Until 1800 teacher education did not have an organised structure. In the first decade of the 19th century, the structural core characteristics of the present teacher education system developed under the influence of Wilhelm von Humboldt. Since then, German federal states have demanded that teachers for the “Gymnasium” undergo a university-based teacher education program leading to a state examination. For Germany, this policy marks the starting point of the teaching profession as a special career (for more details see Blömeke, 2002). In the last decade of the 19th century, a one-year, on-the-job training was introduced as a second phase of teacher education for the “Gymnasium”.

From the 1820s, also teachers for the lower school system received training, and this at teacher training institutions which built on the “Volksschule”. Over the 19th century, these teacher training institutions and their courses were continually expanded (Sandfuchs, 2004), and examinations at the end of the training were introduced. However, teachers at the “Gymnasium” and teachers for the lower schools system were considered to be two totally different professions – and this differentiation can still be observed today.

Organization and Structure of today's German school system

Today's German school system is characterized by a strong selection after the elementary years. The selection process is expected to happen by ability. In reality, a strong socio-economic and ethnic bias has to be noticed (Bos et al., 2007). During the first four years (in two federal states during the first six years) all students attend elementary school, except children with severe

handicaps or learning disorders who attend special needs schools. After grade 4 or 6 selection into three different kinds of middle school representing different kinds of ability takes place. Therefore each student receives a recommendation by his or her class teacher for a certain school type according to the prospective kind of ability. Nonetheless, parents may try to skate over this recommendation and to enrol their child in the school type of their preference. It is up to the principals to decide about this kind of request.

Table 2: Structure of the German school system (cf. Blömeke, Herzig & Tulodziecki, 2007)

			University Education		
13			“Gymnasium” (high school)	„Gesamt- schule“ (compre- hensive school)	“Sonderschule” (several kinds of special-needs schools, attendance depends on the kind of handicap)
12	Several kinds of				
11	vocational schools				
10					
9	“Haupt- schule” (practical abilities)	“Realschule” (secondary modern school)			
8					
7					
6					
5					
4	“Grundschule” (Elementary school) [in Berlin and Brandenburg lasting for six years]				
3					
2					
1					
Grade	Regular school system			Special-needs schools	

The “Hauptschule”, which represents the lowest track of secondary schools, is attended by students whose abilities are considered more practical and less academic in nature. Education in

this type of school ends in most federal states after grade 9 and the teaching is mainly practice-oriented. Students are supposed to become blue-collar workers. The “Realschule” (intermediate track; brit. English: secondary modern school) ends after grade 10 and prepares students for a middle-level career – mainly white-collar workers – in trade and the industry. Only the Gymnasium (highest track) offers the final high-school exit examination (“Abitur”) at the end of grade 12 or 13, depending on the state, qualifying students for studies at the university or equivalent institutions. The exam takes place in at least four school subjects; in more and more federal states it is a centralized exam with anonymous review procedures.

Grade 5 and 6 at middle school are considered an orientation phase, wherein students in principle are allowed to change between the three kinds of schools if their ability does not fit the chosen track. In reality most of these changes are in the downward direction, very few in the opposite.

Aside from these traditional kinds of middle school, more recently comprehensive schools have been introduced. These comprehensive schools were founded in the last 30 years in two different kinds, either simply integrating two or three of the mentioned middle schools (Haupt-, Realschule and Gymnasium) under one roof or offering a streaming of students by individual subjects. The prevalence of comprehensive schools differs widely between federal states (see figure 1). In four out of the five Eastern federal states the majority of students – roughly between 50 and 60% of an age cohort – attends this kind of middle school whereas Hamburg is the only Western federal state with a significant proportion of students at comprehensive schools.

Remarkable differences in the students’ bodies at the other kinds of middle school can be observed, too (see figure 1). For instance, the Hauptschule in the state of Berlin represents a “leftover school” with only the bottom 5 percent of the ability distribution of students attending this school. In contrast, in Bavaria approx. 40 percent of students attend the Hauptschule. Only

the proportion of students attending the highest track, the “Gymnasium” is roughly the same in all 16 federal states: between 25 and 35% of an age cohort.

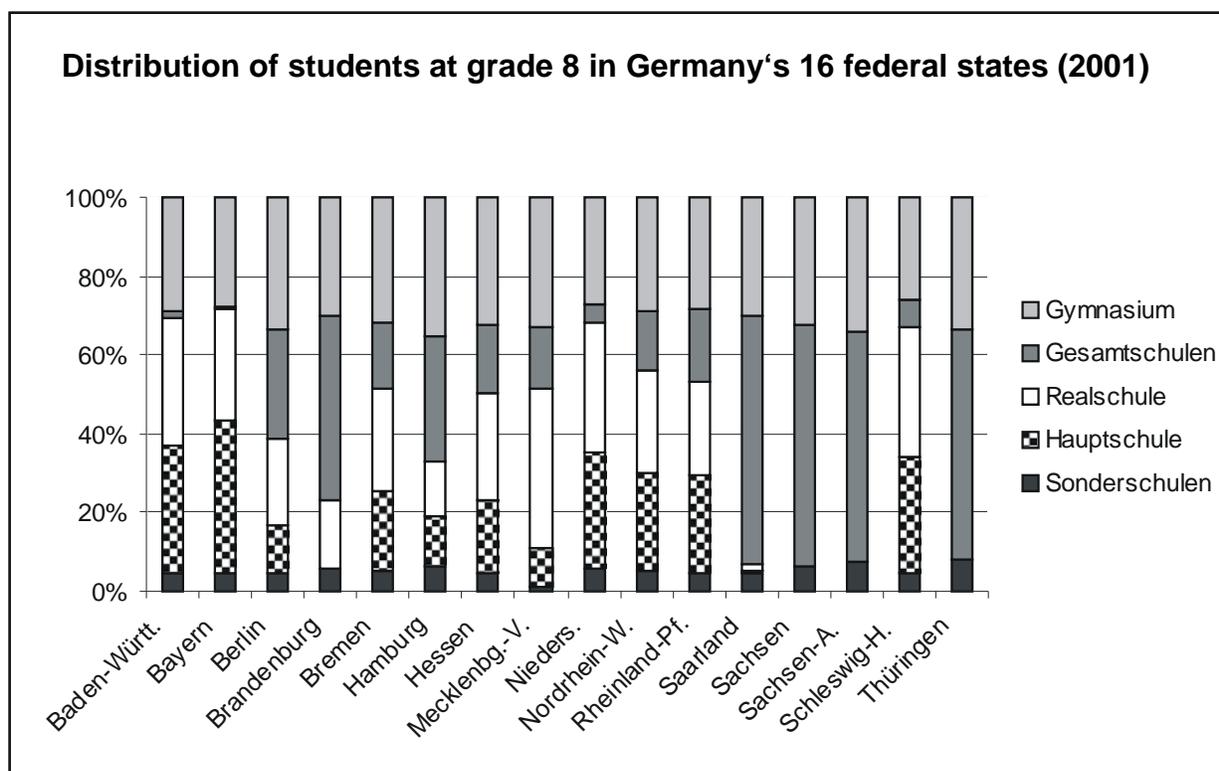


Figure 1: Distribution of students at grade 8 in Germany's 16 federal states (Source: KMK, 2002)

Middle school is followed by an upper-secondary level with a dual system of schools: “Gymnasium” and comprehensive schools with an orientation toward general academic education on the one side, and vocational schools preparing for a vocational career on the other side. Both types afford two or three years of schooling.

About 5 per cent of the student body visits a private school (KMK, 2002). Private schools differ widely in their specific profiles but they all have to follow the state curriculum. The only single type of private schools that represent a significant proportion are “Waldorf schools” which have a special pedagogical profile following Rudolf Steiner’s ideas.

Since education is a matter of the federal states, they provide the majority of the funding (more than 80%; see figure 2). Local authorities provide only one eighth of the funding, and only 5% of the funding comes from the national level. Schools are funded according to their number of students. Federal states set up a teacher-student-ratio based on class sizes and allocate a corresponding number of teaching positions to every school. Elementary school classes have, on average, 22.1 students while middle school classes have, on average, 24.7 students (OECD, 2006). Each size is only slightly above the OECD average.

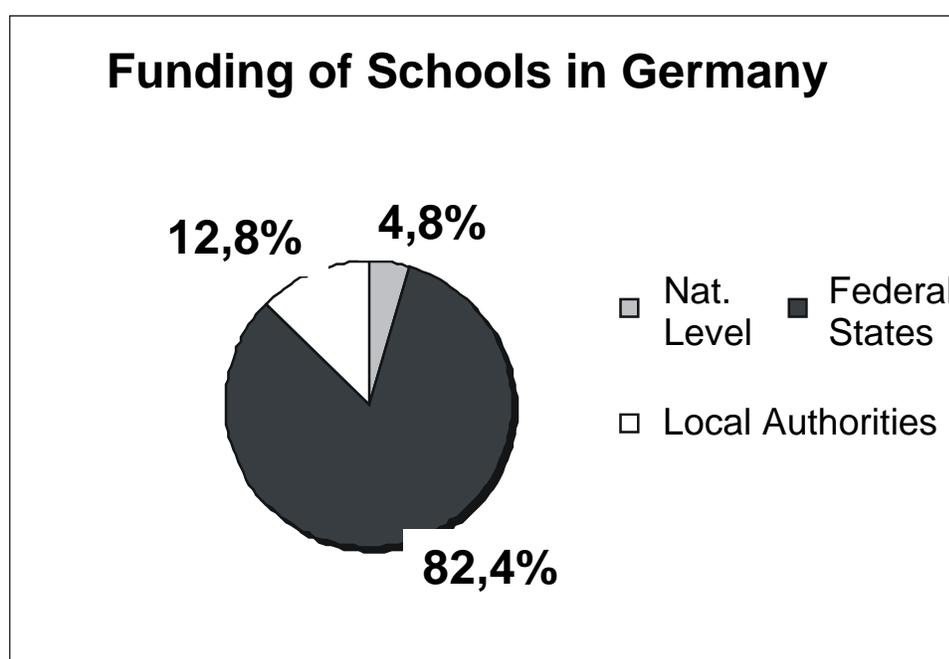


Figure 2: Funding of the German school system (KMK, 2002)

Fully qualified teachers can apply for permanent employment (KMK, 2004a; OECD, 2005). The employment procedures vary across federal states. Teachers apply either at the ministry of education or at the local education authority (*Schulaufsichtsbehörde*). In more and more federal states, the schools themselves play a major role in the selection of teachers. Selection is firstly based on the teachers' subjects and secondly on their grades of the first and the second state examination. In most federal states, teachers are employed as civil servants. However, there are

teachers with salaried employee status, too, employed on a contractual basis. In federal states that belonged to the former GDR, teachers with salaried employee status represent the majority.

The state expenses per student per year are very different regarding school levels (see figure 3). They increase slightly from elementary level to middle school level. On both level they are below the OECD average. The expenses increase drastically when it comes to the upper-secondary level, and in this case they are also much higher as the OECD average. The difference is mainly due to teacher salaries. Elementary and middle school teachers are only junior civil servants whereas teachers at the “Gymnasium” are senior civil servants. Another reason for the higher expenses is a lower teacher-student-ratio on upper-secondary level compared to elementary and middle school.

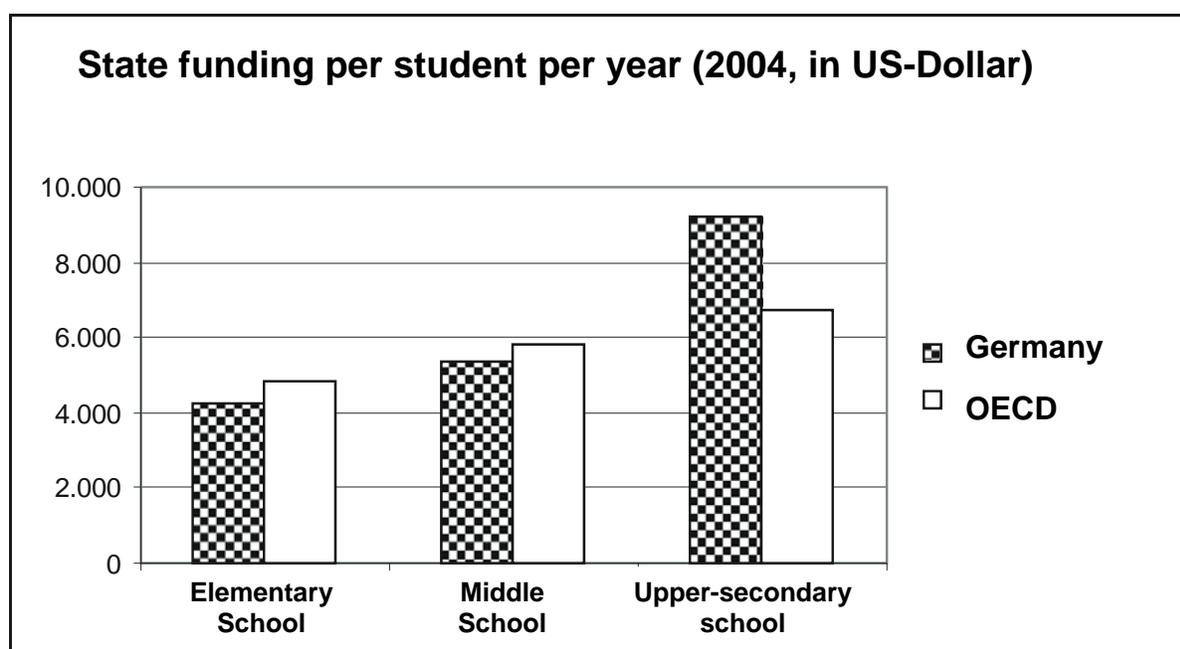


Figure 3: State funding per student per year in Germany compared to the OECD average (2004, in US-Dollar; Source: OECD, 2004)

Teachers for the highly stratified middle-school level are trained in different programs, usually either as part of an elementary school program or as part of a secondary school program. There

are only very few programs specifically designed for middle school. Three levels of regulation exist (national level, federal states, teacher education institutions), each giving rise to considerable variation in the requirements for study of future middle school teachers between federal states as well as between institutions of teacher education. On the national level, teacher education is under the regulation of the *Kultusministerkonferenz* (KMK), which is a committee of the 16 federal states' ministers of education. Here basic guidelines for the arrangement of teacher education programs are negotiated in order to ensure comparability of licensure across all federal states. These basic guidelines include several types of teacher licences (differentiated by school type and grade level), minimum study duration, licensing process, content areas of study, number and kind of practice elements of the curriculum and the duration of practical experiences.

On this general level of description, it has to be pointed out that German teacher education is divided into two phases (KMK, 2006): the academic study at a university as the first phase, and the practical preparatory service (*Vorbereitungsdienst*) as the second phase. The KMK requires for all teaching certificates university studies of at least three years (and pass of a first state examination as the exit exam) and a following practical phase in schools and in teacher education seminars (leading to the second state examination) of at least 18 months. The high-school exit exam ("Abitur") is the minimal qualification required for entry into the first phase of all teacher education programs; in terms of international classification systems, it corresponds to ISCED level 3 (OECD, 1999).

Two kinds of middle school teachers can be differentiated (Bellenberg & Thierack, 2003):

- A) teachers with a teaching licence for either one or all kinds of middle school except the "Gymnasium" (i.e. "Hauptschule", "Realschule" and grades 5 through 10 of comprehensive schools), in many states this licence also qualifies for teaching of the elementary grades;

- B) teachers with a teaching licence for the “Gymnasium” and grades 11 through 13 of comprehensive schools, but explicitly no teaching in primary grades.

The first phase of teacher education for secondary schools (licence B) includes the study of two major subjects including subject-related pedagogy, the study of general pedagogy and practical components related to the study of general pedagogy as well as related to the two subjects. Only those subjects can be chosen that are regularly taught at school. The first phase of teacher education for licence A includes a high proportion of general education, the study of three subjects including subject-related pedagogy (beyond these at least one major subject), and practical components related to the study of general pedagogy as well as related to the three subjects. As elementary school teachers often have to teach all school subjects from grade 1 to 4, the study of German and/or Mathematics is compulsory in almost all federal states. In most federal states the first phase lasts 3.5 (elementary) or 4.5 years (secondary) and the second phase lasts 1.5 (elementary) or 2 years (secondary). So, overall teacher education for middle schools in Germany lasts between 5 and 6.5 years.

Within these framing guidelines issued by the KMK considerable variance exists in the arrangement and requirements of programs between the 16 federal states. For instance, the prescribed number of study hours for *subject-related pedagogy* varies from 8 to 52 hours for licence type A and from 8 to 44 hours for licence type B. Variation in the number of semester hours for *general pedagogy* is even bigger, ranging from 40 to 96 semester hours for type A and 24 to 80 semester hours for type B. The number of hours for the study of each subject varies from 70 to 120 hours for type A and 110 to 160 hours for type B. Again, within these prescriptions of study hours on the federal state level, the content and the quality of study varies across institutions of teacher education. The implemented curriculum of future teachers is usually quite

variable for each individual as students have a great deal of freedom of choice with regard to topics of courses selected by the students. Especially in general pedagogy and also in subject-related pedagogy students are relatively free in their choice of courses and it is very common that no obligatory curriculum regarding the specific content or the sequencing of content and courses for future teacher students exists. Freedom of choice is usually less pronounced in the subjects where a prescription of mandatory courses and their sequencing often exists, especially for the first two years of study.

Both phases end with a high-stakes exit exam. The first state examination (*Erstes Staatsexamen*) consists of several written and oral examinations related to the subjects studied. A thesis on a particular subject is part of the examination as well (*Erste Staatsexamensarbeit*). This first examination is a university degree like a diploma or master and corresponds for elementary as well as for secondary programs to ISCED level 5A First Degree (OECD, 1999). To pass this first examination is the entry requirement for the second phase of teacher education which takes place at specialised teacher training institutions (*Studienseminare*). These institutions are directly under the control of the federal states. The teacher education content of the second phase is determined by the subjects a future teacher has chosen at the beginning of the first phase. Future teachers have to work part-time at schools and attend teacher training courses in general pedagogy and subject-related pedagogy. The second state examination (*Zweites Staatsexamen*) is taken at the end of the second phase. Future Teachers have to teach lessons that are observed and assessed by a board of examiners consisting of school staff, teacher educators and state officials. Furthermore, an essay on a practical issue has to be written (*Zweite Staatsexamensarbeit*). The second state examination corresponds to the ISCED-Level 5A Second Degree (OECD, 1999).

Every federal state has got its own legislative framework for teacher education programmes. However, the KMK has published an agreement (*“Gegenseitige Anerkennung von*

Lehramtsprüfungen und Lehramtsbefähigungen”), with which the first and the second state examinations that are taken in the individual federal states are recognized by the other federal states (KMK, 1999; 2002). This agreement is based on general regulations dealing with the structure and the intended length of the teacher education programs.

Curriculum, Instruction, and Assessment Practices in German middle school

Even if middle school is basically characterised by its stratification, the three kinds of middle school share many cultural features. In all of them, classes remain widely the same from grade 5 through 10. They may split for single lessons, e.g. according to the choice of foreign languages or religious instruction. Most subjects are taught in the students' classroom while teachers move. Usually two students share one table which are in some schools arranged in semi-circles. German schools do not have school uniforms or shared dress codes. In contrast to English-speaking countries, school activities like sports teams, radio stations or TV channels are of much less relevance. Some extra-curricular activities are organized on the class level, e.g. excursions or parents' meetings.

The school year starts after the summer break in August and it is divided up into two semesters. At their ends in January and July report cards are issued. For every subject a grade between 1 as the top mark and 6 as the lowest mark is given. The report card in July decides whether a student can go on to the next grade or whether he or she has to repeat a grade. The latter takes place if a student has more than one “5” in a core subject or more than two “5” in minor subjects and it applies to about 5% of the student body every year (source?). During the school year students have 12 weeks of holidays: six weeks during summer, two weeks in the fall, two weeks around Christmas and two weeks around Easter.

On middle school level students have only few choices regarding their subjects. They have to take German and Mathematics, a first foreign language (usually English, this is determined by the federal state and continues from grade 1 or 3 depending on the state), two sciences (whether it is biology, chemistry or physics is determined by the respective federal state as well) and two social sciences (history, geography, politics again determined by the states) as well as sports, music or arts and religion every year. From grade 6 or 7 on they have to take a second foreign language. Here students have a choice, e.g. between Latin or French. From grade 8 or 9 on students can decide about one more subject out of a broad range of subjects including a third foreign language or bilingual education.

A lesson lasts for 45 minutes. Half-day schooling is the regular schedule in all federal states (see table 3). Three to four times each semester written tests have to be taken in core subjects like mathematics, German and English. They last for one lesson and they are essay based. Multiple-choice tests are widely unknown in Germany. In minor subjects like biology, history or music two or three oral tests or smaller written exercises (“Tests”) are used to diagnose student achievement during the semester.

Table 3: Schedule of a middle-school student at the “Gymnasium” in grade 8 (source?)

	Monday	Tuesday	Wed'day	Thursday	Friday
07.30-8.15	English	Physics	Biology	---	French/Latin
08.20-9.05	French/Latin	Mathematics	German	Maths	French/Latin
09.05-9.25	<i>Break</i>				
09.25-0.10	Music	Sports	Cath./Prot. Religion	German	Biology
10.15-1.00	Cath./Prot. Religion	French/Latin	Maths	English	Social Science
11.00-1.15	<i>Break</i>				
11.15-2.00	German	Arts	Social Science	Information Technology	Sports

12.05-2.50	History	Arts	---	Information Technology	Music
12.50-13.00	<i>Break</i>				
13.00-13.45	Physics	English	---	History	---

Since the curriculum, instruction and assessment practices have a subject-specific profile, in the following mathematics as one of the core subjects in middle school is taken as an example in order to demonstrate more details.

The leading ideas for mathematics instruction as pointed out by federal regulations (“Richtlinien”, “Lehrpläne”) are concerned with the mastery of algorithms and concepts necessary for everyday life in society and other subjects, with the solving and understanding of non-mathematical phenomena through competencies gained in mathematics, with critical thinking and insight into mathematics as a cultural creation, as a theoretical study and as a tool for solving problems (source?). Students should become acquainted with fundamental ideas in mathematics, with methods for getting insight, with various levels of argumentation and representation and with the history of mathematics. The correct use of mathematical language and terms as well as the use of formal notations is considered very important and thus frequently reinforced. Units of teaching usually cover large areas of mathematical content, whereas an approach to teaching according to a spiral curriculum is seldom used.

How these general goals of mathematics instruction are translated into instruction and how much of the overall time of schooling is devoted to mathematics differs between grade levels, school types, single schools and (regarding instruction) also between single teachers. In the elementary grades mathematics is taught five lessons per week and constitutes approximately 20 percent of the overall instruction time in these grades (source?). In middle school grades the percentage of

mathematics lessons drops to 13 percent with nonetheless three to four lessons of mathematics per week. There is no streaming of students within the three kinds of middle school.

The content of mathematics is about the same in the three kinds of schools. In grades 5 and 6 the use of variables in simple equations, fundamental geometric concepts, elementary number theory and fractions are taught. In grades 7 and 8 relations and functions, congruence transformations, angle measurement and associated theorems, linear equations, algebraic structures and integers and rational numbers are taught. Finally, in the last two years of middle schools, in grade 9 and 10 real numbers, quadratic functions and equations, theorems on right triangles and circles, exponential functions and trigonometry are taught. Although there are no significant differences in the content of mathematics, there are major differences in the didactical approach between the three kinds of middle schools (source?): At the “Hauptschule” teaching and learning of mathematics is orientated toward elementary rules and algorithms. Teachers use example-bound explanations and mainly real-world examples but do not require theoretical reflections and proofs. At the “Realschule” teaching is similar to that in the “Hauptschule” but more ambitious in the choice of problems and algorithms, and teachers require some theoretical reflection and reasoning of students. In contrast, in the “Gymnasium” the emphasis of instruction is on general education, and thus theorems and general rules of mathematics are the focus of instruction. Proofs and the acquisition of insight are regarded as important, but at the same time less real-world examples as in the Haupt- or Realschule are used.

Assessment in mathematics instruction is partly regulated by national prescriptions (source?), i.e. regarding the number of tests during a term and the relation of written to oral tests (50:50 in early years and 70:30 in the later years), but at the same time very teacher-based. Teachers assess an individual students' achievement on the basis of this students' participation in classroom-discussions, his or her homework and his or her results in written tests.

Textbooks used for instruction require permission of the state authorities, whereas the teacher is relatively free in choosing or creating additional material for instruction, as i.e. worksheets, computer simulations etc. Until recently there have been national examination standards only for the high-school exit exam “Abitur” specifying the necessary knowledge of students in general. After the PISA “shock” of 2001 when the results of the PISA study of 2000 were published in which Germany did very badly, nationwide standards for mathematics instruction for grades 4, 9 and 10 were developed.

3 OUTCOMES OF THE SCHOOLING OF YOUNG ADOLSCENTS

Academic Performance Outcomes

Western Germany as one of the former front countries during the Cold War was deeply affected by the so-called “Sputnik shock” in the 1960s. That the USSR – as the leading nation for the Eastern bloc – was the first to be able to send a satellite into the space raised doubts about the level of technical knowledge in the country, followed by inquiries on its educational system. In the following decades serious innovations were discussed with several reforms implemented. Nevertheless, in IEA’s Third International Mathematics and Science Study (TIMSS) from 1995 Germany ended up statistically significant lower than the international average (source?). The study especially revealed deficits of German middle school students in their ability to model mathematically and to lead mathematical argumentations. The study also identified difficulties in the execution of complex operations and the independent solution of problems by students. Furthermore a larger amount of German students exhibit only rudimentary mathematical abilities compared to more successful countries as Schweden or Switzerland. Five, eight and eleven years later OECD’s Program for International Student Assessment (PISA) confirmed the TIMSS-

results by still showing Germany only in the middle field of the industrialized countries (see figure 4).

Other Important Outcomes

In general, the teaching of mathematics at secondary schools can be described as very poor regarding the variation of teaching methods (as identified by the TIMS-Video Study; [source?](#)) with one prevailing teaching method, the guided class discussion. Typically a mathematics lesson starts with the introduction of a complex problem, often representing a real-world example. But instead for students working on the problem with its full complexity in groups or individually, the problem is solved by a class discussion, with the teachers guiding the students to the correct solution in a stepwise manner. Thereby the original complexity of the problem is reduced, so that students only have to give simple answers involving the mere recall of definitions and facts or the execution of simple solution procedures. Since the teacher follows a previously planned questioning strategy, which converges at the correct solution of the problem as the teacher himself conceives it, usually no alternative or student approaches to problem solving are discussed. At the end of the lesson the previously developed mathematical procedure or concept is practised by students individually.

However, currently, in part as a response to these findings, a new orientation in mathematics education is demanded: with attention shifting to mathematization and mathematical modelling in order for students to learn the usefulness of mathematics for other sciences and also real life ([source?](#)). Furthermore the cooperation between teachers of mathematics and other subjects is emphasized in order to create forms of integrated teaching and learning. Last but not least portraying mathematics in instruction as a history of core ideas is supposed to make students aware of the contribution of mathematics to our culture. The problem is that such fundamental

changes in mentality and acting patterns are difficult to realize, especially in an institution like school. Even if all participants follow the same goals, such changes will need at least 10 or 15 years before being realized widely.

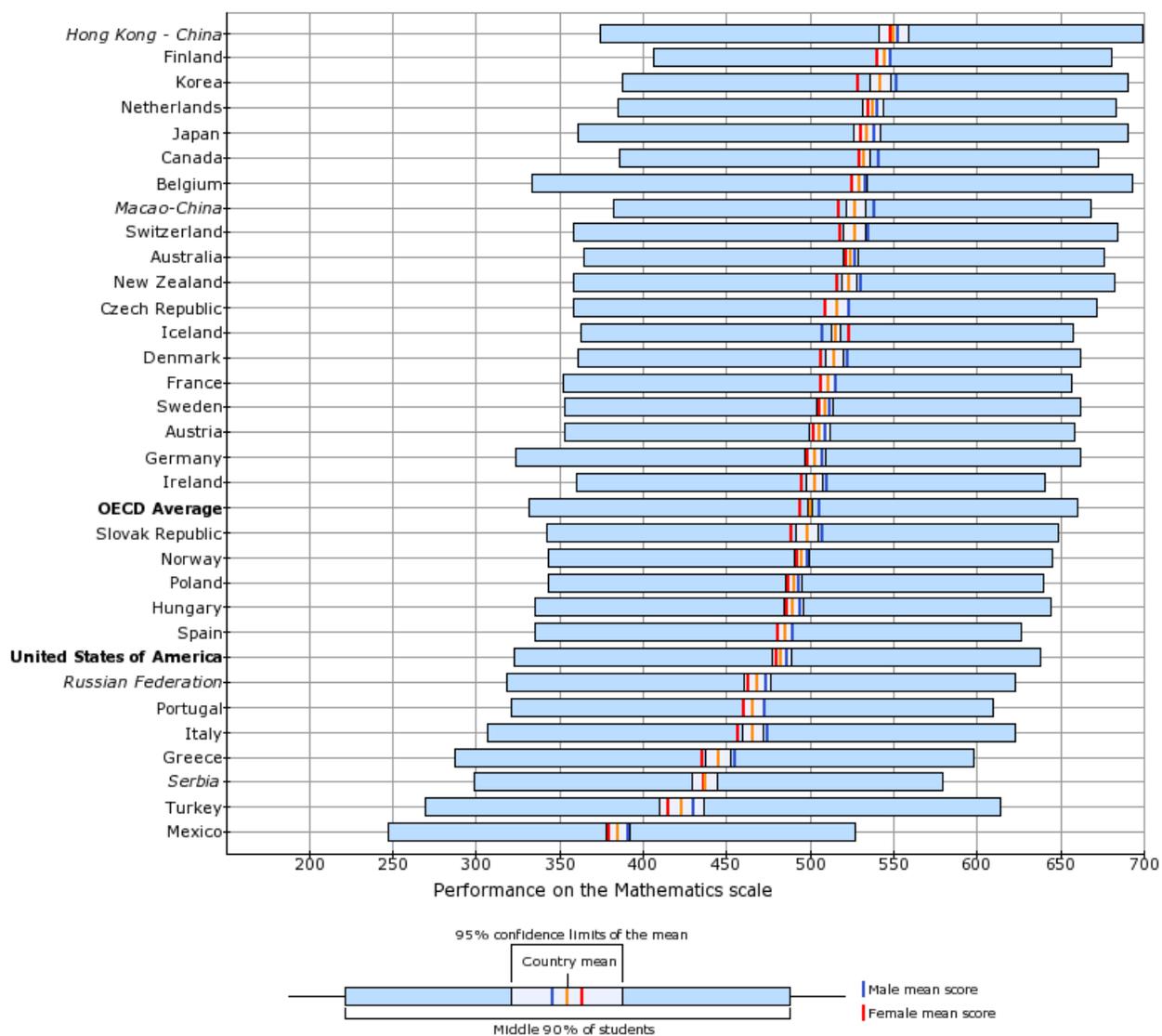


Figure 4: (source?)

4. CURRENT ISSUES RELATED TO THE SCHOOLING OF YOUNG ADOLESCENTS

Besides the on average bad performance of German students in international comparisons the biggest concern is currently related to the association between family background and pupil achievement. Regarding this, Germany was the second highest in the world (OECD, 2001, 2004). Germany's press has given much attention to this result, leading to heated debates among policy makers, researchers and lay people. Various reasons for the disturbed relationship have been discussed. Discussions about the school structure emerged because of the distribution of student achievement in the three kinds of middle school (see figure 5). There is a large overlap in the achievement of students at the "Hauptschule", "Realschule" and "Gymnasium" but their economic and societal chances after school are very different. Only those students at the "Gymnasium" do have a chance to get into university and with this into the higher level of the labor market whereas especially the "Hauptschule" can be regarded as a kind of "dead end".

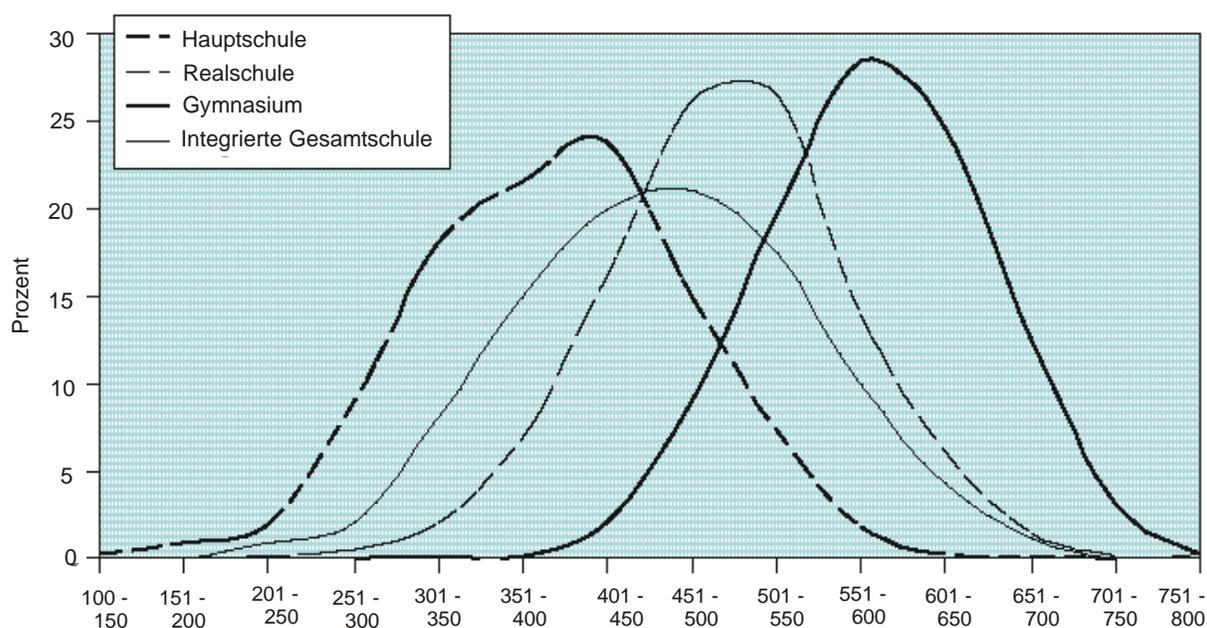


Figure 5: (source?)

Discussions are further enhanced by the selection bias at the end of elementary school. Comparisons of student achievement in PIRLS and teachers' recommendations show that it is much easier for a child from an upper-middle class family to receive a recommendation for the "Gymnasium" than for a child from a lower-middle class family (see table 4).

Table 4: (source?)

<i>Points needed to be nominated for Gymnasium</i>		
	<i>teachers</i>	<i>parents</i>
<i>children from upper-middle class</i>	537	498
<i>children from lower-middle class</i>	569	559
<i>children from upper working class</i>	592	583
<i>children from lower working class</i>	614	606

The consequence of this bias which obviously has already been in place for a long time (source?) is a skewed distribution of social class background in the three kinds of middle school (see figure 6). In a democratic society this kind of bias is not defensible.

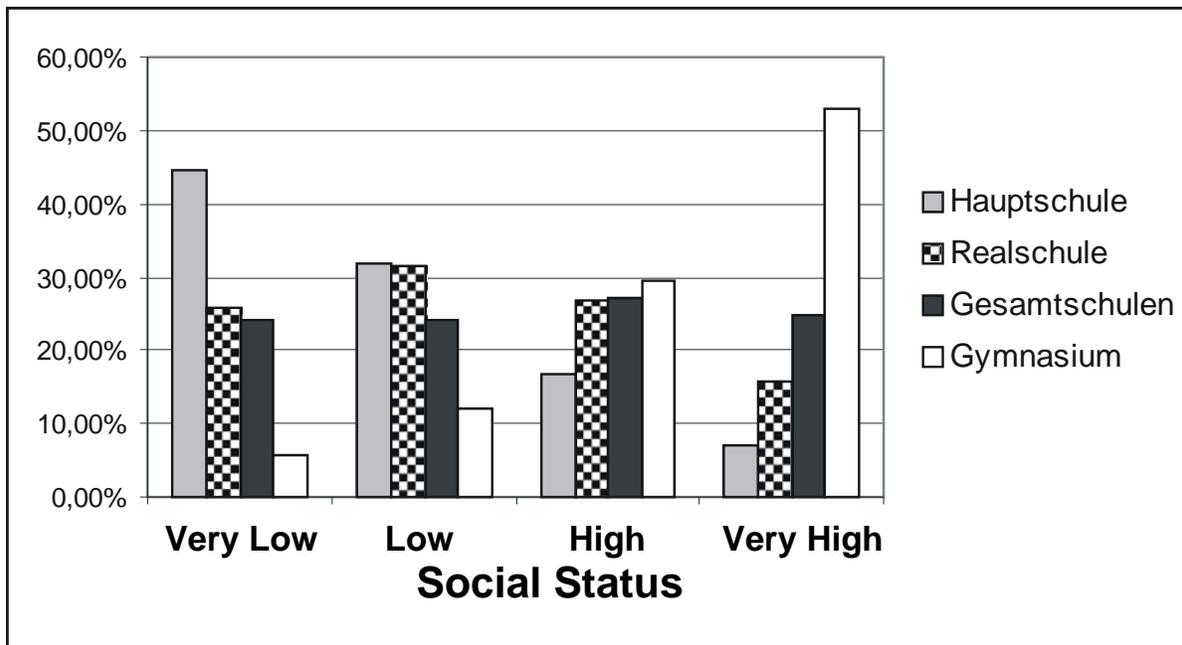


Figure 6: (source?)

5. REFORM INITIATIVES AND NATIONAL POLICIES

Even if policy discussions started about the structure of the German school system, most reform initiatives are currently focussing on higher education and especially on teacher education. Two important initiatives are the transition of university programs to bachelor/master-degrees (BA/MA) as we know them from English-speaking countries and the implementation of a European wide credit point system (ECTS = European Credit Transfer System). The main purpose of these changes is to make achievement of students comparable across the European Union (source?). Study duration for bachelor programs is specified as ranging from 3 to maximum 4 years with study loads of 180 ECTS. A final thesis (6 ECTS) is required. Study duration for master programs is specified as ranging from 1 to maximum 2 years with study loads of 60 resp. 120 ECTS for two year programs. Furthermore entrance to a master program can be

restricted and a selection of students based on their achievements in previous BA studies is possible. The curriculum of BA/MA-programs has to be organised into modules, which can be finished by students within a semester or a year, ensuing a better “study-ability” of programs.

In order to make new BA/MA-licences comparable to traditional teacher education programs according to KMK regulations the new programs have to incorporate the following criteria

(source?):

- a) BA and MA programs for teachers have to include two subjects, general and subject-specific pedagogy as well as practical phases already during the BA program
- b) study duration should range from 7 to 9 semester (without practical phases) and the programs are differentiated by the kind of middle school
- c) the content of the MA exam has to be comparable to the former first state examination even if it is now a pure university responsibility.

Regarding future middle school teachers most of the federal states follow a consecutive model of teacher education in the first phase. A bachelor and a masters degree has to be acquired in order to become a teacher. As the requirements for BA/MA degrees are strongly oriented towards the old programs also the above mentioned distinction into licence type A and B holds for these new programs. Most of the type A programs require study durations of 3 years for the BA phase and 1 years for the master phase of education, for licence type B 3 and 2 years are required respectively. Opposed to a demand made by the European Union regarding the polyvalence of bachelor degrees, most new programs require of students to decide in the beginning of their bachelor studies, whether they would like to have an option on becoming a teacher. In this case, they have to attend specific courses and practica specific for future teacher students, which are not required for students without an option on the teaching profession.

As a measure of quality assurance accreditation of the new BA/MA teacher education programs by an independent Council is demanded. The council consists of representatives of the 16 federal states, teacher education institutions and students. An issue that has not been resolved yet is whether students who have successfully completed a teaching program with a Master degree have a legal claim for entering the second phase of teacher education (as has been the case in the traditional programs upon successful completion of the first state examination).

Currently 2/3 of the federal states have implemented programs of teacher education to be finished with a BA/MA degree, at least as model programs at single universities; the other federal states are planning to follow (except Bavaria and Baden-Württemberg).

6 RESEARCH

Current Research Topics

The 1990s saw a strong development in research on student achievement on the middle school level (see e.g. ...). This research was mostly connected to large international comparisons like PISA or TIMSS. It led to sophisticated methods of sampling as well as of data analyses, e.g. multi-level modeling of student achievement, scaling of data according to the Item Response Theory and more appropriate approaches to dealing with missings than before. Extensive empirical research exists also on classroom instruction – at least for those subjects inquired in PISA and TIMSS, i.e. mainly mathematics and science (Bishop, 1991; Leung, 1995; Schmidt et al., 1997; Kaiser, 1999; Hiebert et al., 2003). In contrast, the current state of research on teacher education is lacking. Only recently has there been research on qualifications of employed mathematics teachers (Ball & Bass, 2003; Hill, 2007; Ferrini-Mundy et al., 2006; Schmidt et al., 2006; Brunner et al., 2006). So, currently the focus of research is changing towards teacher education. To test professional competencies of future teachers and to grasp opportunities to learn

in teacher education beyond distal indicators like certification or majors are two new approaches to inquire the effectiveness of middle school teacher education. They require a careful, theory-driven definition of “professional competencies” as the core dependant variable and a model how teacher education is expected to influence the acquisition of the future teachers’ professional competencies.

The value added by doing teacher education research this way is to overcome the main deficits of the existing state of research: Teacher-education research lacks a common theoretical basis which prevents a convincing development of instruments and makes it difficult to connect the studies to each other. Recently, especially the 800-pages AERA volume “Studying teacher education” led to this conclusion (Cochran-Smith & Zeichner, 2005). There is a lack of research pertaining to studies related to specific fields. It makes a difference to inquire English teachers or science teachers, mathematics teachers or history teachers (Shulman, 1985). The subject represents an increasingly important feature, may be even a bias, which is dangerous to neglect in order to avoid false conclusions about the efficacy of teacher education.

In many countries recent efforts to improve the education of future middle school teachers have been driven by the idea that increasing their subject matter knowledge will improve their practice yielding better-educated students (Darling-Hammond, 1996; Shulman, 1987). However, until now convincing empirical analyses of teacher education that can support this or other hypotheses is virtually non-existent (Houston, 1990; Sikula, Buttery & Guyton, 1996; Wilson, Floden & Ferrini-Mundy, 2001; Blömeke, 2004). The few studies actually carried out rely on indicators that can only insufficiently describe the kind of education a future teacher had experienced or his/her professional knowledge. Regardless how common it is to use majors, the number of courses taken or examination results as indicators (see e.g. Akiba, LeTendre & Scribner, 2007; Goldhaber & Brewer, 2000; Monk & King, 1994), this approach is of high risk to wash out any

kind of relationship between opportunities to learn in teacher education and its outcomes. This methodological weakness results in a disturbing inconsistency of study results due to the huge differences in what it means to hold a “major” or a teaching licence. Differences between programs overlay differences between programs. On this basis almost any inference can be drawn: teacher education might or might not matter, personality might or might not matter (see e.g. Abell Foundation 2001a, b versus Darling-Hammond, 2000).

Methodologies

As it was the case with research of student achievement the recent focus on teacher education was triggered by international comparisons. Germany was included in the six-country study “Mathematics Teaching for the 21st Century” (*MT21*; Schmidt et al., 2007; Blömeke, Kaiser & Lehmann, 2008) as well as in the larger IEA study “Teacher education and development: Learning to teach mathematics” (*TEDS-M*; Tatto et al., 2004). International comparisons give an implicit benchmark since some countries do better in studies like TIMSS or PISA than others. This suggests that their teacher education might consist of more reasonable features than those systems of countries that do relatively badly. So, if one carefully samples the countries participating in a cross-country study the comparisons are quite meaningful. However, analyzing teacher education for international comparisons is a particular challenge, too. Differences in the structure of teacher education make acquiring comparable data complicated, and different meanings of the constructs inquired make the interpretation of the results complicated. Unfortunately, there is nothing in teacher education “that share a relatively common meaning across various cultural contexts” (Akiba, LeTendre & Scribner, 2007). On the other hand, it is precisely this phenomenon that represents one of the values added to nationally bounded research. The variety of manifestations makes hidden national characteristics visible. Like

Table 5: Core tasks of middle school teachers (Source: Blömeke, 2005, p. 4)

Teacher tasks	Situations
A: Choice of themes, methods; sequencing of learning processes	1. Selecting and justifying content of instruction 2. Designing and evaluating of lessons
B: Assessment of student achievement; counselling of students/parents	1. Diagnosing student achievement, learning processes, misconceptions, preconditions 2. Assessing students 3. Counselling students and parents 4. Dealing with errors, giving feedback
C: Support of students' social, moral, emotional development	1. Establishing teacher-student relationship 2. Foster the development of morals and values 3. Dealing with student risks 4. Prevention of, coping with discipline problems
D: School development	1. Initiating, facilitating cooperation 2. Understanding of school evaluation
E: Professional ethics	1. Accepting the responsibility of a teacher

everyone else, researchers are embedded in their own culture so that they often are not able to recognize matters of culture (Blömeke & Paine, in press).

The central dependent variable of *MT21* and TEDS-M is based on the notion of “professional competencies”. *MT21* defines these in reference to Weinert (1999, 2001) as core professional tasks that teachers must be able to master (Bromme, 1992, pp. 73 ff.). Middle school teachers are expected to master tasks like instruction, assessment and the nurturing of students’ social and emotional development (see table 5). To accomplish these two tasks teachers need cognitive abilities and skills in terms of professional knowledge as well as professional convictions and conception of values in terms of beliefs. In *MT21* as well as in TEDS-M data on these components is gathered on a large scale, in TEDS-M in addition with representative samples.

A multifaceted approach was chosen in describing learning opportunities in teacher education. In the tradition of other studies, above all else those of the International Association for the Evaluation of Educational Achievement (IEA), *MT21* distinguishes at the institutional level between intended and implemented characteristics of teacher education. The individual

instruments are largely organized in parallel to one another. The facets are: an expert survey about the formally designated requirements, a document analysis of a sample of course offerings, a survey of teacher educators as mediators of the educational offerings, as well as a survey of the future teachers. Thus, *MT21* can for the first time provide differentiated empirical results for professional competencies of future mathematics teachers in middle schools as an outcome of teacher education. The following table provides an overview of the model of relevant levels and factors in *MT21* (source: Blömeke, Felbrich & Müller, 2008).

Macro level	Level III	Cultural context				
		Rationale of the society	Social status of the teaching profession		Social status of mathematics	
	Level II	Education system				
		Rationale of the education system		Goals of schooling	Working conditions of teachers	
	Level I	Teacher-education system				
Goals of teacher education		Content structure	Institutional structure	Relationship of theory and	Selectivity	

Meso level	Level II	Institutionally intended curriculum					
		Learning goals and content	Teaching methods	Accountability	Academic advising	Selectivity	
	Level I	Teacher educators			Institutionally implemented curriculum		
		Knowledge	Beliefs	Demographics	Learning goals/content	Teaching methods	Selectivity
		Intended learning goals		Intended teaching methods		Accountability	Academic advising

Micro level	Level II	Individual FTs preconceptions		Individual FTs use of curriculum			
		Knowledge	Beliefs	Perception of learning goals and use of content		Experience of teaching methods	
		Personality	Demographics	Accountability		Academic advising	Selectivity
				Amount of learning time		Learning strategies	Emotions
	Level I	Individual FTs competencies					
		Knowledge	Beliefs		Personality		Demographics

Important Research Findings

The *MT21* data lead to the following main conclusions about the effectiveness of teacher education for middle school (for more details see Schmidt et al., 2007):

- Significant differences were noted among the six countries participating in *MT21* (Bulgaria, Germany, Mexico, South Korea, Taiwan and the US) in terms of the mathematics, the mathematics pedagogy and the general pedagogical knowledge of future teachers.
- Important differences were noted in the nature of the preparation future lower secondary teachers received across countries as well. This was true both in terms of the mathematics topics studied as well as the mathematics pedagogy and general pedagogy topics studied.
- Teacher education matters! Future teachers' knowledge and beliefs depend heavily on how they are trained. They gain knowledge in those fields emphasized in teacher education and their beliefs change in accordance with the curriculum taught at their institutions.
- Regarding mathematical knowledge, future middle school teachers trained as part of an elementary program are at a disadvantage compared to future middle school teachers trained as part of a secondary program.
- There are, however, noteworthy relative strengths and weaknesses associated with the respective routes. Again, these reflect the amount of emphasis in the corresponding teacher-education programs. Middle school teachers trained as part of an elementary program outperform middle school teachers trained as part of a secondary program as far as pedagogical knowledge is concerned. Taking into account that both mathematical knowledge and pedagogical knowledge are required to teach well, deficits may exist in both types of middle school teacher education.

- Multilevel analyses show that it makes a difference in which institution a candidate is trained. Future teachers with more extensive training in each of the three areas do better on the *MT21* tests than teachers elsewhere.

7 FUTURE DIRECTIONS

One of the core challenges of future research is to connect research on student achievement, instruction and teacher education. One subject should be to externally validate the above mentioned findings about professional competencies of middle school teachers as a function of teacher education, e.g. by testing practicing teachers with the same instrument, observe their performance and assess the achievement of their students.

Another important direction would be to study middle school students and their teachers in a longitudinal design. Most data on both levels comes from cross-sectional designs meaning that the data is collected at the same time but interpreted in a causal way. Strictly speaking, it would have to be pointed out that causal conclusions are not possible based on cross-sectional data. It is hardly possible to control for the different influences and to decide about causes, conditions and consequences.

Finally, there is a lack of in-depth qualitative studies. Most studies on middle schools triggered by TIMSS and PISA are based on large-scale assessments. These reveal important insights but they are strongly limited regarding the potential to inquire educational processes in a more detailed way. One issue is, for example, how the social bias precisely works that turns out to be in place in teachers' recommendations after grade 4. Another issue is the culture of middle school education. Students at the three different kinds of middle school differ probably very much in their thinking, in their values and in their behavior but how this difference looks like is widely unknown.

8 CONCLUDING DISCUSSION

Middle school in Germany is mainly characterized by its stratification into three different types of school which are supposed to support different kinds or levels of ability. This structure has been in place for more than 100 (three kinds of school) or 200 years now (two kinds of school). So, even if it has been criticized a lot, especially after Germany's bad performance in international comparisons like PISA and TIMSS, it is obviously very hard to change a system that has been in place for such a long time.

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