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Differences in teacher education programmes and their outcomes across *Didaktik* and curriculum traditions

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ABSTRACT

Teacher education is of vital importance for what teachers are capable to do for their pupils, but little is known about student teachers' pedagogical knowledge. The *Didaktik* and the curriculum traditions are two main education approaches underpinning formal schooling and teacher education programmes (TEPs) in the Western world. The main difference between the two traditions lies in the content and objectives of teacher education, which are either theoretical or action-oriented. Two questions are addressed quantitatively: How do teacher education programmes and their outcomes vary across *Didaktik* and curriculum traditions? How do opportunities to learn and beliefs about teaching methods affect mathematical content knowledge (MCK) and mathematical pedagogical content knowledge (MPCK) scores? Empirical data from the Teacher Education and Development Study in Mathematics (TEDS-M) are used, with samples from Norway, Germany, Switzerland, and the US. The study offers alternative explanations for variations of TEPs' outcomes within the Western world.

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Teacher education programmes; *Didaktik*; curriculum; teacher education outcomes; TEDS-M

Introduction and purpose

Since the turn of the century, teacher training has become a politically significant issue across the world. Independent of the actual results of pupils' assessment tests, teachers' general performance is regarded as insufficient (Barber and Mourshed 2007; Anderson and Krathwohl 2001). Today, driven by the motif of a nation's inferiority or supremacy, nations define the quality of teacher education as deficient (OECD 2005; UNESCO Institute for Statistics 2006; European Commission 2007; World Bank 2009). Hence, teacher education is viewed as a (growing) policy issue, building on the idea that there is a relationship between pupils' (primarily socially and culturally determined) performance and teacher education.

Globally, teacher education seems to build on a radical change, reflecting policy makers' distrust of teacher educators' professionalisation efforts. Following a UNESCO initiative (van der Leeuw-roord 1998), teacher education programmes have altered their metanarratives. Indeed, institutions are now focusing on pupils' learning and not on learning to teach.

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Current handbooks on teacher education (Townsend and Bates 2007; Loughran and Hamilton 2016; Clandinin and Husu 2017) reveal that teacher education incorporates topics such as rational organisation and the management of schooling, the development of pupils' learning outcomes as well as school development. Furthermore, emphasis is being placed on the introduction of research-based teacher education concepts. At the organisational level, the majority of countries have introduced master programmes as a proxy for high-quality teacher education and as an indicator of (future) excellent teaching in school.

On reviewing recent research on teacher education (Tatto 2007; Hill-Jackson and Lewis 2010; Darling-Hammond and Lieberman 2012; Furlong, Cochran-Smith, and Brennan 2013; Akiba 2013; Moon 2013; Trippestad, Swennen, and Werler 2017), we can note that teacher education institutions often struggle with governmental ordinances as they fail to develop a holistic understanding of education quality. In addition, teacher education institutions worry about the consequences of implementing standardisation and accountability strategies, putting the autonomy of teacher education at risk. Finally, teacher education struggles with recruitment and certification issues as well as with programme design, as is shown by numerous – about 1300 – teacher education programmes in the US for example (Trippestad, Swennen, and Werler 2017).

In summary, it can be stated that the frontline of teacher education is marked by policy-driven efforts primarily with the aim of increasing student teachers' knowledge of subject matter and pedagogical content in order to facilitate pupils' achievements. Moreover, less emphasis is being placed on the development of future teachers' pedagogical competence (Trippestad, Swennen, and Werler 2017).

In examining Teacher Education and Development Study in Mathematics (TEDS-M) 2008 data as an international comparative student teacher-focused study, the purpose of this investigation is to unpack differences in initial teacher education programmes (TEPs) from the perspectives of *Didaktik* and curriculum education traditions, constituting a novel and nuanced approach to examining international large-scale data sets through educationally grounded theoretical lenses. TEDS-M's goal was to provide empirical cross-national studies on how individual national teacher education programmes (TEPs) train future mathematics' teachers and the outcomes of those TEPs. The specific aims of the present study are the following: first, to analyse variations in those programmes among the sample countries; second, to examine TEPs' outcomes in terms of future teachers' opportunities to learn (OTLs) about teaching methods and beliefs; and third, to consider the association of select OTLs and beliefs with future teachers' mathematical content knowledge (MCK) and mathematical pedagogical content knowledge (MPCK) scores. To achieve these aims, two overarching questions are addressed: (1) How do initial teacher education programmes and their outcomes (MCK and MPCK) as well as OTLs and beliefs about teaching methods vary across *Didaktik* and curriculum traditions, focusing on future primary and secondary student teacher samples from Norway, Germany, Switzerland and the United States? (2) How do OTLs and beliefs about teaching methods affect the MCK and MPCK scores across the four countries in the sample? The paper proceeds as follows: first, an elaboration of the theoretical framework based on *Didaktik* and curriculum education traditions is offered; second, an associated literature review is provided; third, the data and methods are presented and explained; fourth, the results and findings as per the two research questions are provided; fifth, the article ends with a discussion and a conclusion.

Didaktik and curriculum education traditions as theoretical frameworks

To frame this study and to discuss its results, we rely on and borrow from the two main educational traditions in the Western world: the *Didaktik*- and *Bildung*-based education tradition, which predominates in continental and Nordic Europe; and the curriculum education tradition, which predominates in English-speaking countries (Westbury 2000; Deng and Luke 2008; Tahirsylaj 2019). In brief, the *Didaktik* education tradition is teacher-oriented in that teachers enjoy professional autonomy and responsibility; it is content-focused, meaning the content rather than the methods drives teaching and learning processes in the classroom; and it relies on the concept of *Bildung*, which is a theorisation of individuals' development through formal schooling in order that they become independent and capable of using reason on their own in their decision making (for detailed elaborations, see Westbury 2000; Hopmann 2007; Tahirsylaj, Niebert, and Duschl 2015; Tahirsylaj 2019).

Further, the Didaktik culture in teacher education looks at the aims, the contents and the methods of schooling (teaching) from a macro perspective. With its starting point in a national curriculum, this culture asks how to transform and reproduce the respective culture of the nation/region. Hopmann (2007) points out that the purpose of teaching and schooling in Didaktik culture is to transport knowledge from society to a learner. Hence, the aim of teacher education programmes is to enable student teachers to establish teaching and learning situations that unfold various learning processes that link the student`s self with the world. Hence, teaching in teacher education will be characterised as an offer of meaning-making. In such teacher education programmes, student teachers learn professional skills such as to structure, sequence, simplify, organise and communicate teaching contents in order to facilitate student studying and learning processes (Uljens 1997). From a content perspective, student teachers learn theories of Didaktik in order to conceptually manage his or her reality and thus develop his/her activities. The main purpose of Didaktik-based teacher education is therefore to give prospective teachers the opportunity to develop both their personal Didaktik thinking and actions based on those theories. Based on the culture of pedagogical freedom/autonomy student teachers are able (should be able) to provide lessons reflecting possible meaning(s) for their future students (Westbury 2000).

On the other hand, the curriculum tradition was developed in and expanded across English-speaking countries in Europe, North America and Oceania; its conceptualisation poses it as a tradition that is institution-oriented, whereby institutions rather than individual agents such as teachers assume primacy; it is methods-focused, the idea being to pay more attention to methods than to the content of teaching; and it is evaluation-intensive, highlighting the importance placed on both students' and institutions' performance, primarily through students' test scores (Westbury 2000; Deng and Luke 2008; Tahirsylaj 2017). Similarly to *Didaktik*, various curriculum perspectives have been developed over time, with social efficiency, focusing on the efficiency of schools in producing (or raising) students' test scores, predominating (for a detailed discussion, see Deng and Luke 2008; Tahirsylaj 2017).

Further, the curriculum culture in teacher education focuses on the goals of student learning. In this tradition a student teacher will learn to consider how a student learns to be able to do or to know, whereby student teachers also will learn to evaluate the degree

to which the learning goals have been reached by a student. Teacher education programmes in a curriculum tradition emphasise the binding objectives of learning. It views teaching in the light of measurable standards. Primary aim of teacher education in the curriculum tradition is to create opportunities of learning that help student teachers to master a professional practice, where students must achieve pre-defined outcomes. Student teachers learn in this tradition to build (local) school systems based on a rationalised, managerial framework. Through teacher education, they learn to plan, to define learning objectives, to deliver instruction, to test and assess students learning as well as how they are enabled to deliver (local) curriculum evaluation. Hence, the practice of the teaching profession is characterised by a performative aspect. Reid (1997) argues that such teacher education provision is based primarily on pragmatism and not so much on theory. Much of this culture is rooted in the work of Ralph Tyler (1949) on the foundation of curriculum making.

Given the differences in the foundations of teacher education across didaktik and curriculum traditions, one can expect that student teachers' learning outcomes regarding MCK and MPCK as well as OTLs and beliefs about teaching methods will vary. It might also be possible that OTLs and beliefs about teaching methods affect MCK and MPCK learning outcomes differently. These two education traditions and their corresponding theoretical underpinnings have been under-utilised in previous empirical research focusing on quantitative methodologies. Next, we provide on overview of related previous research

Literature review on prior secondary analyses with TEDS-M data

Here we provide a brief overview of secondary research building on TEDS-M data, including studies by both independent and TEDS-M related researchers. The few secondary analyses available seem to fall into three thematic categories: analyses that take the construction of nations as explanatory; culture-related analyses that build upon an assumed dichotomy between an Eastern and a Western culture; and analyses that assume the value or importance of praxis.

The national perspective

A study about future primary teachers' knowledge of mathematics and pedagogy (Blömeke, Suhl, and Kaiser 2011) has outlined significant differences regarding the equality and the quality of teacher education programmes. The findings suggest that a nation's culture has an impact on the effectiveness of teacher education. In investigating the impact of culture on future teachers' conceptualisations of the nature of mathematics, Felbrich, Kaiser, and Schmotz (2014) describe the country-specific profiles of teachers' beliefs. Guided by the cultural psychological concept of Hofstede (1986, 2001) and ipsative value analysis, it is reasonable to group Norway, Switzerland and Germany together. Teacher candidates in these countries stress the dynamic nature of mathematics. In contrast, American student teachers portray a mediating position, arguing for a more static form of mathematics. Consequently, it is possible to argue that future teachers' beliefs seem to correspond to countries' historic education culture.

Given the historically varying development of teacher education, Senk et al. (2012) find in their descriptive study a correlation between nation-building processes on the one

hand and variations in teacher education structure and future teachers' MCK and MPCK on the other. A possible explanation might be found in differences in school and curriculum culture. In questioning the comprehensiveness of mathematics teacher education curriculum, Blömeke (2012) concludes that the professional preparation of future teachers varies across countries because it is tied to national cultural values that are manifested in everyday practices of education (Alexander 2001; Tobin, Hsueh, and Karasawa 2009).

In addition, Blömeke (2012) demonstrated that in none of the participating countries was cultural diversity the dominant focus of teacher. This finding underlines the national impetus of teacher education programmes. In consider the OTL profiles of primary teacher education in TEDS-M countries Blömeke and Kaiser (2014) have recognised that there is no common core curriculum in TEDS-M countries, whether in mathematics pedagogy, general pedagogy or in mathematics as a subject. This has been partially confirmed at the secondary level by Wang and Tang (2013), who have shown that programmes focus either on comprehensive coverage of TEDS-M topics or on OTL related to school practice.

East-West dichotomy

With respect to student teachers' achievement patterns, Kaiser and Blömeke (2014) suggest that it is possible to create country-specific teacher competence profiles, following an East-West dichotomy. Their analysis shows that future teachers from Norway, Switzerland and Germany hold a dynamic and student-focused orientation towards the teaching of mathematics. In contrast, teachers from the United States exhibit a balanced view, while teachers from East Asia show a content-related view (see Figure 2 in Kaiser and Blömeke 2014, 527]).

Regarding future teachers' perceptions of 'mathematics-as-a fixed-ability', Braeken and Blömeke (2016) have confirmed earlier findings (Vieluf and Klieme 2011) that teachers in nations like the United States, Chile, Norway, Germany and Switzerland share the belief that competence in mathematics is not fixed. According to these researchers, future teachers in other countries hold either a strong belief (Thailand, Malaysia and the Philippines) or an intermediate position (Taiwan, Singapore, Poland and Russia). Criticising – like Hofstede – the association between nation and culture, Hsieh (2013) has analysed the scope and substance of Taiwanese and Western teacher education regarding different types of mathematics teachers' knowledge, revealing a clear East Asian identity of MPCK as a result.

Relevance of praxis

In investigating the quality of teacher education, Hsieh et al. (2011) have applied a self-developed analytical stand-alone framework. They have shown that student teachers benefit from both academic and school-based instructors in participating countries. However, future teachers tend to be more critical than teacher educators about teacher education programmes. Studying the impact of in-school OTL on general pedagogical knowledge (GPK) development, König and Blömeke (2012) have demonstrated that in-school practicums represent a valuable component of effective teacher education both in Germany and the United States.

Critical discussion of the TEDS-M approach

As any large-scale study, TEDS-M puts high epistemological demands on itself. However, it is apparent from previous analyses that TEDS-M builds on the simplistic idea that teacher education is largely the same in terms of function and content across the world. Thus, such studies have been built on the assumption that all participating countries provide opportunities to learn MCK, MPCK and GPK, that these opportunities are relevant for good teaching quality and that the applied three-item model is necessarily appropriate.

As this literature review has shown, the master narrative for the majority of analyses presents either the nation or the East-West dichotomy. However, such a perspective is biased because it fails to take into account how nations can build on intra-national heterogeneity and inhabitants do not necessarily share a common value structure. Regarding the East-West dichotomy, it is worth noting that the related studies build on the assumption that there is a fixed concept of culture. Both master narratives construct regional unification and overlook forms of hybridity. Their findings thus lead to unsatisfactory explanations of the results they yield, merely attributing them to the idea that national or cultural spheres are explanatory factors.

TEDS-M as proxy: an alternative approach to address the research question(s)

In this study, we do not treat Germany, Switzerland, Norway and the United States as a group. With regard to the data material, we instead suggest grouping the unit of investigation according to language families (either Anglophone or Germanophone), especially given that the field is language-sensitive. These countries additionally share a similar political worldview and build upon a Christian heritage that has special relevance for education theory. It has also been suggested elsewhere that these countries represent a cultural- and language-based dichotomy, resulting in curriculum- or didactic-driven teacher education (Tahirsylaj 2019). In other words, the group consisting of Norway, Switzerland and Germany stands out as representatives of the *Didaktik* and *Bildung* tradition whereas the United States represents the curriculum culture. Relying on the fact that there is a *Didaktik* and curriculum-oriented teacher education culture, it is interesting to seek differences regarding teachers' beliefs and OTLs related to these distinct pedagogical approaches.

To offer alternative explanations, we suggest analysing the TEDS-M data through educational theoretical lenses. Such a strategy is reasonable and possible because there is no predetermined operationalisation of TEDS-M indicators. Hence, we have the possibility of using these variables as proxies in the research process. As a result, it is possible to regroup or dissolve variables and test for the influence of certain variables on MCK/MPCK.

Data and methods

This study uses TEDS-M data, collected from 2007 to 2008 in 17 countries[1] Brese and Tatto 2012), which were made available to the researchers for secondary analyses following a formal request to the International Association for the Evaluation of Educational Achievement (IEA) Research and Analysis Unit in Amsterdam, The Netherlands. Whereas

TEDS-M targeted institutions, educators already teaching and future primary and lower-secondary teachers, our study only relies on data related to future primary and lower-secondary teachers and merely focuses on the four countries of interest – Germany, Switzerland, Norway and the United States – in line with its theoretical framing and research questions. Following Tahirsylaj's (2019) elaboration on grouping countries along the *Didaktik* and curriculum continuum, which is based on four criteria, including historical, cultural, empirical, and practical, Germany, Switzerland and Norway represent *Didaktik* while the United States represents the curriculum tradition. TEDS-M collected data from all of the varied teacher education programmes (TEPs) within the countries, with Table 1 (primary level) and Table 2 (lower secondary level) presenting the specific TEPs in the four countries considered here, alongside descriptive statistics on the MCK and MPCK scores by TEP within them, including corresponding sample sizes.

TEDS-M followed two-stage stratified sampling to ensure randomised representation and it used item response theory (IRT) scaling for the proficiency scores of future primary and lower-secondary teachers on MCK and MPCK (Brese and Tatto 2012). The TEDS-M international database made available also included a number of OTL and beliefs indices, several of which are examined in the present study to address the two research questions. In the interest of space, descriptive statistics for all variables of interest in the present study are available upon request, with the exception of MCK and MPCK, as these are already provided in Tables 1 and 2 above. The descriptive statistical data, together with the MCK and MPCK scores for future primary and lower secondary teachers, constitute the basis for addressing the first research question on the variation in select variables across *Didaktik* and curriculum traditions as well as the second research question on the

Table 1. Descriptive statistics for MCK and MPCK across primary level TEPs across countries in the sample (Weighted).

COUNTRY	LEVEL AT WHICH GRADUATES QUALIFY TO TEACH – PRIMARY	Variable	N (listwise)	Min.	Max.	Mean	Std. Deviation
Germany	LOWER PRIMARY GENERALIST (GRADE 4 MAXIMUM)	MCK	5025	5.00	885.14	500.70	81.97
		MPCK	5025	98.48	888.39	491.23	93.30
	PRIMARY MATHEMATICS SPECIALIST	MCK	1093	336.56	799.02	555.25	73.96
		MPCK	1093	227.76	702.34	552.26	66.32
Switzerland	LOWER PRIMARY GENERALIST (GRADE 4 MAXIMUM)	MCK	160	357.08	714.83	512.17	62.96
		MPCK	160	195.82	675.18	518.94	71.74
	PRIMARY GENERALIST (GRADE 6 MAXIMUM)	MCK	1092	335.09	781.36	547.94	65.03
		MPCK	1092	306.27	867.58	539.45	62.09
United States	PRIMARY GENERALIST (GRADE 6 MAXIMUM)	MCK	16159	325.73	799.02	517.52	70.01
		MPCK	16159	195.82	794.64	543.57	67.60
	PRIMARY MATHEMATICS SPECIALIST	MCK	2433	341.88	765.51	519.98	63.01
		MPCK	2433	382.58	888.39	544.49	72.64
Norway (ALU)	PRIMARY/LOWER SECONDARY GENERALIST (GRADE 10 MAXIMUM)	MCK	1429	262.36	785.82	508.72	69.37
		MPCK	1429	358.35	757.57	539.27	60.79
Norway (ALU +)	PRIMARY/LOWER SECONDARY GENERALIST (GRADE 10 MAXIMUM)	MCK	433	379.32	894.01	552.78	74.09
		MPCK	433	383.17	757.57	564.39	69.88

Source: IEA's TEDS-M 2008 Database.

Table 2. Descriptive statistics for MCK and MPCK across lower secondary level TEPs across countries in the sample (Weighted).

COUNTRY	LEVEL AT WHICH GRADUATES QUALIFY TO TEACH – LOWER SECONDARY	Variable	N (listwise)	Minimum	Maximum	Mean	Std. Deviation
Germany	LOWER SECONDARY (GRADE 10 MAXIMUM)	MCK	2176	5.00	746.22	483.35	82.89
		MPCK	2176	65.66	844.66	515.46	89.05
	LOWER AND UPPER SECONDARY (TO GRADE 11 AND ABOVE)	MCK	1199	342.74	901.94	584.59	74.71
		MPCK	1199	174.34	849.11	585.73	90.75
Switzerland	LOWER SECONDARY (GRADE 10 MAXIMUM)	MCK	177	393.47	691.20	531.06	50.11
		MPCK	177	391.79	836.30	548.62	72.11
United States	LOWER SECONDARY (GRADE 10 MAXIMUM)	MCK	2849	344.82	666.74	467.75	46.40
		MPCK	2849	347.54	727.15	470.73	53.16
	LOWER AND UPPER SECONDARY (TO GRADE 11 AND ABOVE)	MCK	2256	379.49	724.62	552.88	57.11
		MPCK	2256	347.54	849.11	542.26	79.45
Norway (ALU)	LOWER SECONDARY (GRADE 10 MAXIMUM)	MCK	1448	141.23	566.92	435.27	60.96
		MPCK	1448	169.25	627.97	455.10	68.96
Norway (ALU +)	LOWER SECONDARY (GRADE 10 MAXIMUM)	MCK	471	171.90	592.641	461.18	61.94
		MPCK	471	279.01	727.147	480.05	72.61
Norway (PPU)	LOWER AND UPPER SECONDARY (TO GRADE 11 AND ABOVE)	MCK	106	357.04	704.037	502.82	65.90
		MPCK	106	279.01	844.66	494.47	92.37

Source: IEA's TEDS-M 2008 Database.

associations of OTL and beliefs items with MCK and MPCK. Therefore, they appear in various graphical and table representations in the Results section. Next, a more critical and detailed elaboration on key aspects of TEDS-M data, namely MCK, MPCK, OTL and beliefs, is offered. This appears first as a summary of the TEDS-M study and prior approaches to its data and accompanying analyses; and second as an explanation of the different approach the present study takes to analyse and interpret the results and findings.

The story of TEDS-M: MCK, MPCK, OTLs and beliefs

The TEDS-M study explored how student teachers are trained and what knowledge and beliefs they hold on entering the profession. In order to achieve those objectives, TEDS-M applied the concept of OTL alongside achievement tests and investigations of teachers' beliefs to determine cross-national differences (Tatto et al. 2012; Tatto 2013). TEDS-M assessed student teachers' learning outcomes, building upon a simplified model (Blömeke and Kaiser 2014; Tatto et al. 2012) of teacher knowledge developed by Shulman (1986a, 1986b, 1987). The testing involved teacher candidates in their final year of education from 17 countries (Brese and Tatto 2012).

MCK and MPCK

According to the technical documentation available (Brese and Tatto 2012; Tatto et al. 2012), the tests included student teachers' MCK, MPCK (Shulman 1986a) and GPK for countries including the United States, Germany and Taiwan (Shulman 1987). TEDS-M

defined MCK as knowledge of fundamental mathematical definitions, concepts, algorithms and procedures, whereas MPCK as including teaching-related knowledge about how to present fundamental mathematical concepts and methods in order to adapt to students' prior knowledge. MPCK was also said to include curricular knowledge (Shulman 1986b). GPK testing comprised student teachers' 'generic knowledge about learners and learning, assessment and educational contexts and purposes' (Blömeke and Kaiser 2014, 22) as well as classroom-related knowledge (Shulman 1987). The present study only focuses on MCK and MPCK scores, which were developed through tests using one-dimensional models and applying item response theory (Brese and Tatto 2012; Tatto et al. 2012).

OTL

As indicated above, TEDS-M asked student teachers about their experiences of OTL in several domains, such as mathematics content, mathematics education pedagogy, general education/pedagogy and school-based experiences (see Tatto et al. 2008). According to the technical TEDS-M documentation, OTL is framed by Husén's (1967) classical concept. Hence, an OTL pertains to '[w]hether or not … students have had the opportunity to study a particular topic' (Husén 1967, as quoted in Tatto et al. 2008, 52). Teacher education programmes have been described as creating time allowed for learning (Carroll 1963). However, an OTL also incorporates content conceptualised in teacher training (Floden 2002). Therefore, OTLs reflect particular visions of the knowledge and skills that primary and lower secondary teachers are expected to develop. Blömeke and Kaiser (2014) justify the importance of OTL by arguing with McDonnell (1995), explaining that cross-national differences in teacher competence (MCK, MPCK) are caused by cross-national differences in teachers' OTLs.

Beliefs

Building on Deng (1995), Tatto (1996, 1998, 1999, 2003), Grigutsch, Raatz, and Törner (1998), and Ingvarson, Beavis, and Kleinhenz (2007), TEDS-M examined student teachers' beliefs about what they teach and how they teach (Tatto 2013). Such beliefs have been described as collective imaginations that have considerable influence on teaching (Tatto et al. 2008). Surprisingly, the term 'teacher beliefs' was not elaborated in the technical TEDS-M reports. Nevertheless, a scientific publication on TEDS-M has specified that 'beliefs are in TEDS-M […] understood as student teachers' understandings, premises or propositions about the world that are felt to be true' (Richardson 1996, as quoted in Blömeke and Kaiser 2014, 22). TEDS-M investigated five areas of beliefs, including: (1) beliefs about the nature of mathematics; (2) beliefs about learning mathematics; (3) beliefs about mathematics achievement; (4) beliefs about preparedness for teaching mathematics; and (5) beliefs about programme effectiveness (Tatto et al. 2008). The present study only focuses on the latter two. For both the OTL and beliefs indices as developed by TEDS-M, a neutral value was set to 10.

To address the two research questions, data analysis is undertaken here in two steps. In the first step, descriptive analyses are performed, relying on country mean comparisons of the MCK, MPCK and OTL and beliefs variables, with independent t-tests run to compare the results between *Didaktik* and curriculum traditions. In the second step of the analysis and to address the second research question, we rely on within-country multiple linear

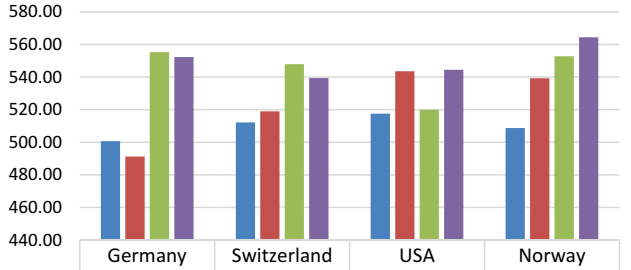
regression methods to test the factors that are associated with MCK and MPCK scores as dependent variables across various TEPs within each of the four countries in the sample. Independent variables for these analyses include seven OTL indices (instructional practice, instructional planning, assessment uses, assessment practice, teaching for diversity, teaching for reflecting on practice and programme coherence) and two beliefs indices (preparedness for teaching mathematics and quality of instruction), while additionally controlling for participants' age and number of books as a proxy for socioeconomic status (SES). The base form of the multiple linear regression models is as follows:

$$\text{MCK or MPCK score}_i = \beta_0 + \beta_1 x_{1i} + \ldots + \beta_{11} x_{11i} + e_i \quad (1)$$

where β_0 is the constant for the model, $\beta_1 x_{1i}$ to $\beta_{11} x_{11i}$ represent the independent variables included in the model and e_i is the respondent-specific error component. The model is run for each of the countries included in the sample and for each targeted primary or lower secondary TEP within the country as instructed through TEDS-M international database documentation (Brese and Tatto 2012). List-wise case deletion is applied with regard to missing data, while appropriate design and sampling weights as suggested by TEDS-M documentation are applied when running the statistical analyses and models in order to obtain unbiased estimates. IEA's IDB Analyser and Stata statistical software are used to perform the analyses.

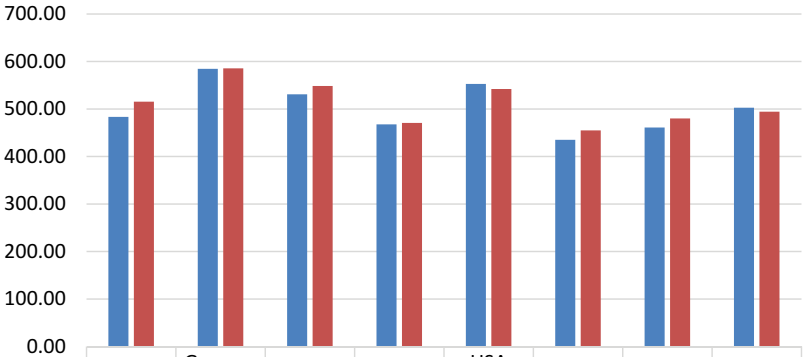
Results

This section presents the results in the following order: first, the MCK and MPCK average scores for both primary- (Figure 1) and secondary- (Figure 2) level TEPs across sample countries are shown; second, the mean scores of the OTL (Figure 3) and beliefs (Figure 4) items are presented only for primary-level TEPs across countries in the sample (the results for the secondary level are not shown in the interest of space, but they are available upon request); and third, the results of the multivariate regression analysis for primary-level TEPs are provided (again due to word limitations, the results for secondary-level TEPs are not shown, but they are available upon request).



	Germany	Switzerland	USA	Norway
Primary Generalist (MCK)	500.70	512.17	517.52	508.72
Primary Generalist (MPCK)	491.23	518.94	543.57	539.27
Primary Specialist (MCK)	555.25	547.94	519.98	552.78
Primary Specialist MPCK)	552.26	539.45	544.49	564.39

Figure 1. Means of MCK and MPCK scores across primary level TEPs across four countries.



	Germany (Lower Sec.)	Germany (Lower and Upper Sec.)	Switzerland (Lower Sec.)	USA (Lower Sec.)	USA (Lower and Upper Sec.)	Norway (ALU)	Norway (ALU +)	Norway (PPU)
MCK	483.35	584.59	531.06	467.75	552.88	435.27	461.18	502.82
MPCK	515.46	585.73	548.62	470.73	542.26	455.10	480.05	494.47

Figure 2. Means of MCK and MPCK scores across secondary level TEPs across four countries.

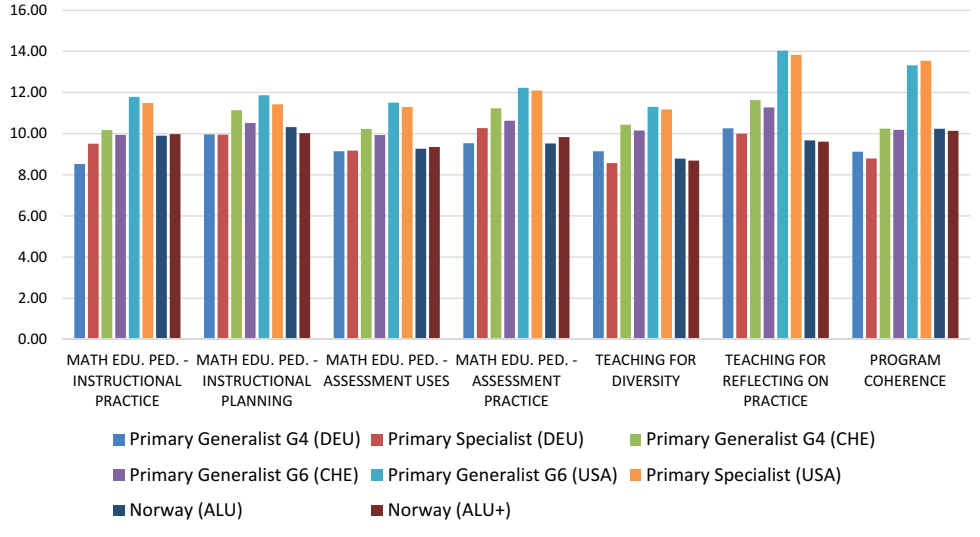


Figure 3. Means of seven OTL items for primary level TEPs in Germany, Switzerland, USA, and Norway.

Means of MCK and MPCK scores for primary- and secondary-level TEPs across sample countries

As is already clear from Tables 1 and 2, the four countries in the sample educate future teachers in TEPs that drastically differ from one another, i.e. there is a built-in difference in TEPs across countries considering the initial structures only. While Switzerland and Germany share the same structures, with a generalist and specialist primary TEP up to grade 4, in the United States the TEPs include programmes up to grade 6. Furthermore, Norway is the most distinctive example, providing programmes that prepare primary

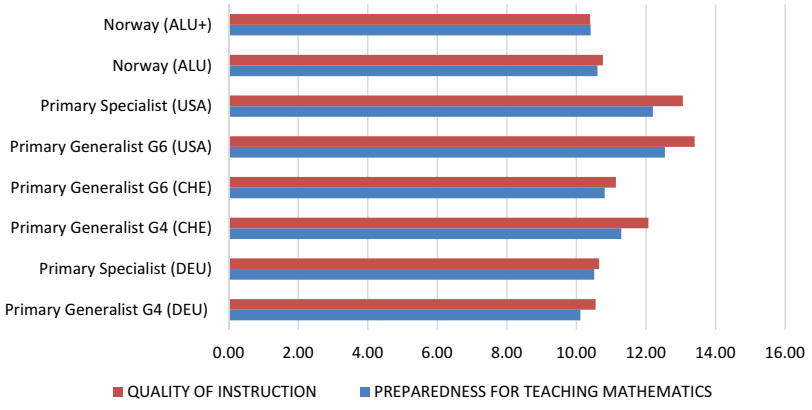


Figure 4. Means of two Beliefs items for primary levels in Germany, Switzerland, USA, and Norway.

teachers up to grade 10. A similar difference is observed in lower-secondary level TEPs across the countries. Accordingly, the results for the performance of future primary and secondary teachers in MCK and MPCK in Figures 1 and 2 are unsurprising; if anything, it is surprising that the variation is not more dramatic.

Figure 1 shows that in all four countries, future teachers in primary mathematics specialist TEPs scored higher in both MCK and MPCK than those in generalist TEPs. This is to be expected given that TEDS-M primarily focuses on mathematics and future teachers in mathematics specialist programmes have received more focused education in mathematics specifically, compared to future teachers in generalist TEPs, who must be educated in other subject domains as well. Furthermore, Figure 1 shows that in all countries and all TEPs (with the exception of primary generalist TEPs in MPCK in Germany), future teachers scored significantly above the international mean of 500. In contrast, at the secondary level (Figure 2) future teachers in most TEPs across countries score below the international mean of 500 in both MCK and MPCK, with Norway clearly achieving lower results.

To test the differences from the education tradition perspectives (i.e. *Didaktik* and curriculum), we created a new data set using the primary-level data of the four countries in the sample, excluding the samples representing primary mathematics specialist TEPs and Norway (ALU+). This data set included a total of 3,573 future primary teachers (935 from Switzerland, 936 from Germany, 1,310 from the United States and 392 from Norway). From this sample we constructed a new variable called *Didaktik* – referring to the grouping of the samples representing Germany, Switzerland and Norway – and *curriculum*, based on the United States sample. An independent-samples t-test was conducted to compare MCK first and MPCK second between the *Didaktik* and curriculum samples. Regarding MCK, a significant difference was observed in the scores for *Didaktik* ($M = 522{,}74$; $SD = 76{,}06$) and curriculum ($M = 512{,}88$; $SD = 69{,}49$); $t(1949) = -3{,}56$, $p < 0.001$). In terms of MPCK, there was a significant difference in the scores for *Didaktik* ($M = 520{,}88$; $SD = 76{,}73$) and curriculum ($M = 541{,}35$; $SD = 67{,}11$); $t(2033) = 7{,}54$; $p < 0.001$). In line with the theoretical underpinnings of the *Didaktik* tradition (which focuses on content) and the curriculum tradition (which focuses on methods), the t-test results showed that future primary teachers in *Didaktik* outperform those in the

curriculum tradition in MCK as a content knowledge test, while the opposite is the case in MPCK as a methods knowledge test.

Means of OTL and beliefs indices for primary-level TEPs in Germany, Switzerland, the United States and Norway

In the TEDS-M study, MCK and MPCK represented the outcomes of TEPs within the participating countries. In addition, TEDS-M collected background data to pinpoint how future teachers experience TEPs during their training. To examine some of the background data collected through TEDS-M, we turn now to a select number of OTL and beliefs items included in the TEDS-M data set in order to explore any potential variation across countries in our sample and specifically between the *Didaktik* and curriculum traditions. Figure 3 shows the means of seven OTL indices, while Figure 4 presents the means of two beliefs indices for primary-level TEPs across countries. The means of the OTL and beliefs items for the secondary level followed the same pattern and in the interests of the word limit they are not shown here, but they are available upon request.

As noted earlier, TEDS-M set a neutral value of 10 for OTL and beliefs indices, hence the graphs in Figures 3 and 4 can be interpreted in terms of whether the means for individual countries are above or below 10. In terms of both OTL and beliefs indices, the United States stood out as an outlier, with means above 10 and thus superior to all of the other countries in the sample. Specifically, future primary teachers in both generalist and specialist TEPs reported higher levels of OTL with regard to instructional practice, instructional planning, assessment uses, assessment practice, teaching for diversity, teaching for reflecting on practice and programme coherence, plus higher levels of beliefs regarding preparedness for teaching mathematics and quality of instruction. The independent samples t-test results for both the OTL and beliefs indices comparing the means of the *Didaktik* and curriculum styles confirmed the observable pattern in the graph, i.e. there is a statistically significant difference in the means of the OTL and beliefs indices between the *Didaktik* and curriculum traditions, in favour of the latter (detailed t-test results are available upon request). Interestingly, when considering the OTL and beliefs indices among the United States future teachers, it could be noted that their reported values also translated into higher MPCK scores but not into higher MCK scores, again indicating that in curriculum traditions, more emphasis is placed on methods (pedagogical content knowledge) rather than on content (content knowledge). However, to further explore this issue statistically, next the results of the multivariate regression analysis are provided to examine whether the OTL and beliefs indices are associated with MCK and MPCK scores.

How do the OTL and beliefs indices affect MCK and MPCK?

In a series of models that regressed seven OTL indices (instructional practice, instructional planning, assessment uses, assessment practice, teaching for diversity, teaching for reflecting on practice and programme coherence) and two beliefs indices (preparedness for teaching mathematics and quality of instruction), while also controlling for teachers' age and number of books at home as a proxy for socioeconomic status (SES) on the MCK and MPCK scores by the specific teacher education programme in each country as suggested by TEDS-M, mixed results were found. Nevertheless, the OTL and beliefs indices were not significant in many of

the programmes and countries (detailed results, including those for the secondary-level TEPs on MCK and MPCK, which showed the same patterns, are available upon request). Although most of the indices were not significant, the results indicated considerable variation both across programmes within a country and between countries. For example, in Germany, only OTL on instructional practice (13.81 in generalist TEP and 25.24 in specialist TEP) and on assessment uses (−4.05 in generalist TEP and −15.36 in specialist TEP) were significantly associated with MCK scores, while in the United States, OTL on assessment uses (−5.13 in generalist TEP) and on teaching for reflecting on practice (−2.53 in generalist TEP) as well as belief about preparedness for teaching mathematics (−7.24 in specialist TEP) were significantly associated with MCK scores. Overall, the OTL and beliefs indices did not seem to contribute to the MCK or MPCK scores of primary future teachers and, especially in the United States, the higher values reported in the OTL and beliefs indices did not contribute to the MCK or MPCK scores. Furthermore, the model fit ranged from an r-square of 0.01 in primary generalist TEPs in Switzerland to 0.36 in primary mathematics specialist TEPs in Germany in the MCK models, implying that the variables in the models lacked strong predictive power to explain the variation in MCK and MPCK performance in the countries in the sample (detailed results for the r-square values for specific programmes and countries are available upon request).

Discussion and conclusions

In this study, we have sought to examine TEDS-M results through the educational lenses of the *Didaktik* and curriculum traditions. The key findings from the results and analyses presented here seem to challenge previous research that has used TEDS-M data to examine the East-West dichotomy. Indeed, the findings of this study clearly show variation in teacher education programmes and their outcomes, both within individual countries and between countries in the sample, even though all four countries belong to the Western world. To this end and as shown in the t-test results when comparing MCK and MPCK scores between *Didaktik* and curriculum countries, the two educational traditions might explain some of the variation in TEPs and their outcomes. The findings are in line with previous conceptualisations of the *Didaktik* and curriculum traditions, as the latter's (United States) means were higher for all of our variables of interest with the exception of MCK, indicating that it is indeed methods-focused, whereas *Didaktik* represents a content-focused tradition.

In terms of the professional knowledge and skills of teachers, their education culture is obviously important. We can see that the MCK results underline that student teachers in Didaktik tradition have developed professional knowledge domains, acknowledging that this knowledge points not to itself. Therefore it is reasonable to conclude that those teachers' driving force for developing teaching is *content* pointing to socially and culturally important issues. On the other hand, we see that student teachers in curriculum tradition are more strongly influenced by *performative aspects*. Their ability to deliver instruction in a methodologically guided way is more distinctive.

Surprisingly, the OTL and beliefs indices in our regression models were in many instances not significantly associated with MCK and MPCK scores across TEPs within and between countries, which may be related to the conceptualisation of MPCK as well as the OTL and beliefs indices in the TEDS-M study. Further research should address

enactment of OTL and beliefs in order to understand their operationalisation and experience as well as possible culturally variations and practical implications.

We can learn from our analyses that in spite of globalisation, teacher education programmes result in different outcomes that are linked to context, thus creating cultural restraints. The fact that we can identify differences in the data within the Western world, despite the application of a hegemonic model (Shulman 1986a, 1986b, 1987), is in line with theoretical predications. The very existence of these differences provides reason to argue that different Western educational philosophies are enacted in the preparation of teachers in the Western world. However, the data available do not offer indications as to how these enactment processes of *Didaktik* and curriculum cultures are operationalised in practice. It is possible that student teachers' experiences of school practicums play a decisive role here. Interregional differences between the *Didaktik* countries suggest that superficially identical educational philosophies may be enacted differently. This leads to the conclusion that teacher education systems and their outcomes are strongly influenced by their national language and the enactment of educational philosophies. Our results point to the special role of the mother tongue in enacting educational ideas for the professionalisation of teachers. Hence, an in-depth analysis of trilingual Switzerland would be of particular value.

On the ethnocentricity of the Shulman model

The analyses carried out so far either follow a data support approach or are determined by a preceding dichotomy. While data-based analysis is blind to cultural peculiarities, the results of dichotomous analysis are given *per se*. Previous analyses seem to blindly trust that the analytical instrument (Shulman model) facilitates reliable analyses of student teachers' competences. Interestingly, the TEDS-M consortium gave rise to justified doubts about the chosen procedure, as it fails to question these basic assumptions even though analyses (especially from Asia) are available. The application of the Shulman model inevitably inserts an ethnocentric culture bias into the TEDS-M programme. By applying it to the TEDS-M approach without discussing any alternatives, the implication is that it is the only globally valid model (see TEDS-M technical documentation). Through affording the Shulman model hegemonic status, conceptual differences in teacher education programmes between countries, regions or cultures cannot be seen.

It almost appears as if teacher education, owing to its highly national enactment, eludes a comparison of outcomes, as these have thus far been obtained through a model that is subject to a cultural bias. This cultural bias results from the fact that MCK, MPCK and GPK models predominated against the background of the highly diversified American teacher education system in the 1980s. This and related models (Voss, Kunter, and Baumert 2011; Kunter et al. 2013) are highly psychologised and are related to pupils' achievement results. However, these models seem to be less unsuitable as universal scales because they have not developed a generic *tertium comparationes*. Even our approach is limited as it excludes educational perspectives from Asia.

Towards a new model

Despite arguments that teacher education has been globalised (Tatto 2007), the TEDS-M findings presented raise doubts. We therefore propose placing greater emphasis on

theoretically and educationally guided analyses of already existing data. These should be limited to particular cultural areas and be offered within the same analyses. Such analytical work will display sensitivity to the value systems of local communities, the cultural heritage of regions and their languages as well as religion's role in teacher education. Hence, a different classification/categorisation of nations is necessary. We view our approach as a first attempt towards research explaining differences between outcome data in four Western countries. Lastly, a less biased approach might be executed through measuring student teachers' public good capabilities (Wolff and De-Shalit 2007; Walker and McLean 2013, 2015), helping pupils to lead a valuable life. Within such an approach, teachers' professionalism comes to be based on a view of teaching and learning that facilitates the expansion of pupils' capabilities in order to choose and derive valuable outcomes (Sen 1999, 2009; Nussbaum 2000, 2011).

Note

1. The 17 countries that participated in the TEDS-M study comprised Botswana, Canada (four provinces), Chile, Chinese Taipei, Georgia, Germany, Malaysia, Norway, Oman (lower-secondary teacher education), the Philippines, Poland, Russia, Singapore, Spain (primary teacher education), Switzerland (German-speaking cantons), Thailand and the United States (public institutions, concurrent and consecutive routes only) (Brese and Tatto 2012).

Disclosure statement

The authors declare that they have no conflict of interest.

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Tobias Christoph Werler's areas of research interest and expertise include educational policy, curriculum theory and didactics, teacher education, philosophy of education, design and implementation of national and international research projects regarding students learning processes and outcomes, and professionalisation of student teachers.

Armend Tahirsylaj's research interests span across a number of domains, primarily pertaining to curriculum theory, *Didaktik*, education policy, teacher education, international large-scale assessments, and international comparative education.

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