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Opportunities to Learn Provided to Preservice Elementary School Mathematics Teachers in Turkey

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Abstract
This study aims to compare the perceptions of pre-service elementary mathematics teachers on the experiences provided by teacher training institutions on a national and an international level. The participants in the study were 1386 pre-service teachers from 21 universities in twelve regions of Turkey. The Learning Opportunities Scales developed by the TEDS-M Project were translated into Turkish by the researchers and used to collect the data. According to the results, the pre-service teachers perceived that they had more opportunities to learn about mathematics pedagogy than about mathematics or general pedagogy. Furthermore, the variations between regions were most pronounced in mathematics pedagogy. Lastly, it can be inferred that there was generally a positive relationship between development level of a region and pre-service teachers' learning opportunities.

Key Words: Pre-service mathematics teachers, opportunity to learn, school mathematics, mathematics pedagogy, general pedagogy

Introduction

Comparative studies in education have seen increasing interest, particularly those with a focus on mathematics teacher training (Schmidt et al., 2007; Tatto et al., 2008). Large-scale international comparative studies have offered valuable insights into the learning-teaching practices and qualifications of teachers or pre-service teachers in various contexts (Blömeke, 2014). In addition to the international focus, such studies are also crucial for comparing pre-service teachers' status at multiple universities that exhibit comparable characteristics within a given country. Through this process, the strengths or weaknesses of the teacher education institutions in individual countries

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may be identified (Blömeke, 2014), and thus highlight the similarities and differences between regions and the wider global context (Blömeke, 2012). Knowledge thus gathered can lead to comparative conclusions regarding the level and nature of the knowledge offered to pre-service teachers, and thus, directly (or indirectly) about the characteristics of the related institutions.

The Mathematics Teaching in the 21st Century (MT-21) project by Schmidt et al. (2007) and the Teacher Education and Development Study in Mathematics (TEDS-M) project by Tatto et al. (2008) were the first studies carried out on an international scale to take a comparative view of the knowledge and beliefs of pre-service teachers worldwide, as well as the learning opportunities with which they were provided (Blömeke, 2012; Tatto et al., 2012). Initially, the MT-21 project focused on the mathematics teaching knowledge and attitudes towards mathematics of pre-service teachers in six countries.

Expanding on this work, the TEDS-M study analyzed the mathematics teaching knowledge and attitudes towards mathematics of pre-service teachers, as well as the learning opportunities provided by their teacher training programs, from a much wider perspective. A review of the literature reveals that the knowledge and attitudes of the teachers played an active role in the planning, implementation, and assessment of learning and teaching activities and hence affected students' achievement levels in mathematics (Baumert et al., 2010; Hill, Rowan, & Ball, 2005; Fennema & Franke, 1992; Lloyd & Wilson 1998; Stein, Baxter, & Leinhardt 1990; van Dooren, Verschaffel, & Onghena 2002).

Moreover, it has been revealed that the knowledge and attitudes the pre-service teachers may serve as an important indicator of the success of a given teacher training program (Tatto et al., 2008). While both studies focused on mathematics teaching knowledge and pre-service teachers' attitudes towards mathematics, because the opportunities to learn afforded to pre-service teachers also play a role in shaping their knowledge and attitudes (Blömeke & Kaiser 2014; Tatto et al., 2008; Tatto et al., 2012), they are likewise important matters to consider.

In a general sense, the opportunities to learn offered by a given teacher education program reflect the educational policies and vision of the institution. Such opportunities reveal the types of knowledge and skills the program intends to instill in its graduates and the procedures it implements to do so (Blömeke & Kaiser, 2014; Schmidt et al., 2007). As every choice offers certain opportunities to learn, the choices made for national programs, in this sense, reflect what is to be expected of the teachers, what they are supposed to do in the classroom, and how teacher training is organized to provide them with the knowledge and skills required for successful performance (Blömeke, Suhl, Kaiser, & Döhrmann, 2014). In other words, the opportunities to learn offered to future teachers reflect the program's, as well as the wider nation's perspectives on teaching as a profession. Numerous studies on this topic underscore the quality of the opportunities to learn and their impact on the performance and motivation levels of the individual (Kleickmann et al., 2013).

A glance at the comparative education research carried out in Turkey reveals a limited perspective, as the focus is primarily on comparisons with the teaching programs or teacher training programs of other countries (e.g. Aldemir, 2010; Coşkun, 2009; Erbilgin & Boz, 2013; Ergün & Ersoy, 2016; Kalkanlı, 2009; Küçükoğlu & Kızıltaş, 2012). Erbilgin and Boz (2013), for instance, compared teacher training programs in Turkey with three different countries: Finland, Singapore and Japan, which were selected according to their results on the TIMSS 2011 and PISA 2009. Moreover, Ergün and Ersoy (2016) compared aspects such as admission criteria, the process of education, school experience and teaching practice, lectures offered throughout all programs, graduation requirements and criteria for becoming a teacher for primary teacher education system in The Netherlands, Romania and Turkey. These studies provide general comparisons in terms of their objectives and their results. However, in the national context in Turkey, there is a need for more specific comparisons in terms of both specific fields (such as mathematics teacher education) and specific variables (such as learning opportunities).

The characteristics to be identified through comparative research on education can aid in ascribing significance to similarities and differences in programs by making connections between the structure of the related societies, their development levels, and their cultural characteristics from both regional and global perspectives. These efforts can provide policymakers and stakeholders with important insights concerning the policies necessary for carrying out certain reforms or other measures. Several existing studies presenting comparative results about student achievement levels are useful in this context, and many countries have revised their school systems in consideration of their findings (Blömeke, 2014; Bütüner & Güler, 2017; Grek, 2009). For instance, the mediocre achievement levels achieved by Germany on the PISA 2000 following an extended hiatus in participation in that study produced a minor shock in the country, leading to a revision of the system after extended discussions among policymakers and researchers (Blömeke, 2014; Knodel, Windzio, & Martens, 2014). Likewise, Turkey's achievement levels in studies such as TIMSS and PISA, which could be labeled as failure, provided input for recent program revisions at the elementary and secondary school levels. The PISA results also led to renewed debates on the education system in light of differences in achievement levels among Turkish schools. Further comprehensive comparative studies with pre-service teachers may likewise stimulate new discussion, both nationally and internationally, concerning the learning opportunities offered to prospective teachers in faculties of education.

Overview of Teacher Education in Turkey

To clarify the context in which the study takes place and underscore the significance of the results, it is useful to provide some background information on the history and structure of the Turkish approach to teacher education. In Turkey, the responsibility for teacher formation for all grade levels belongs to faculties of education at the nation's public and private universities. The structure of teacher education has been revised numerous times over the years (in 1997, 2006, 2009, and most recently, in 2018) in order to promote teacher quality. The most significant features are outlined below, as they will be relevant to the later discussion.

- In many fields, elementary and secondary teacher education have been implemented as separate programs. In terms of mathematics, two different programs are offered for pre-service teachers: secondary school (9-12 grade) and elementary school (5-8 grade).
- Efforts have been made to establish a standard in terms of number of courses, course content and number credits among different faculties of education.
- The content of the courses taught in the faculties of education has been arranged to increase exposure to school mathematics.
- The diversity and credit hours for practice-based courses such as School Experience and Teaching Practice have been increased.
- The type and credit hours of courses related to content teaching (such as Specialized Teaching Methods 1 and Specialized Teaching Methods 2) have been increased.
- The number of elective courses has been increased (CHE, 2007).

These regulations, originally established in 1997, were updated in 2006 and 2009. The course content of all teacher education programs comprises 50% content knowledge and pedagogical content knowledge; 30% professional knowledge of teaching; and 20% general culture knowledge (CHE, 2007). In addition, each faculty of education has the leeway to determine elective courses comprising 25% of the total credits offered. In this regard, in accordance with the principle of creating flexible learning pathways in higher education put forth by the Bologna process (CHE, 2015), attempts have been made to increase the number of elective courses and to reduce the number of compulsory courses in order to make the programs more flexible.

Although the program changes made in 2018 seem to protect the above percentages in terms of the weight of content knowledge, teaching profession knowledge and general culture knowledge courses (CHE, 2018), they have been criticized by teacher educators on two key points, in particular: (i) the reduction of the number and hours of the content knowledge courses to below a reasonable level; (ii) the giving of responsibility for courses on teacher professional knowledge (such as Psychology of

Education, Classroom Management, Teaching Principles and Methods, Introductory of Educational Sciences) to educational scientists, rather than teacher educators.

However, the regulations made in 2018 will not be implemented as of the academic year 2018-2019, and thus, they do not affect the period in which the current study was conducted. On the other hand, the results obtained from this study will lead to new discussions about the suitability of the changes made in the context of these most recent regulations.

Curriculum content of elementary mathematics teacher education programs

As with all teacher education programs, mathematics teacher education is standardized throughout Turkey, with the exception of flexibility in terms of the electives offered. The courses taught in elementary mathematics education programs, which are the focus of this study, are presented in Table 1.

Table 1.
Courses taught in elementary mathematics education programs

Course Types	Course name
Content knowledge courses	Abstract Mathematics I and II, Introduction to Algebra, Physics I and II, Analysis I, II and III, Linear Algebra I and II, Graphic Analysis, Analytical Geometry I and II, Statistics, Probability, Differential equations, Theory of Numbers.
Pedagogical content knowledge courses	Instructional Technology and Material design, Specialized Teaching Methods I and II, Assessment and Evaluation in Mathematics Education, School Practice, School Experience, History of Mathematics, Special Education in Mathematics Education, Computer-supported Instruction in Mathematics Education.
Teaching profession courses	Psychology of Education, Introductory of Educational Sciences, Teaching Principles and Methods, Classroom Management.
General culture courses	Turkish I and II, English I and II, History of Ataturk's Principles and Reforms I and II, Information Communication Technology, History of Science, History of Turkish Education.
*Elective courses	Environmental Education, Mathematics and Life, Field Research in ME, Creative Drama, Problem-solving in Mathematics, Contemporary Approaches in ME, Science, Technology and Society.

*Although teacher education program is common, elective courses may vary from university to university.

All but one of the 21 universities surveyed in the current study offered programming according to the structure presented in Table 1. The content knowledge courses consist of advanced mathematical knowledge beyond school mathematics. For example, the Analysis I objectives are composed of limit, continuity, derivative, indefinite and definite integral topics and arc length, area and volume relations. However, contrary to the content knowledge courses, pedagogical content knowledge courses are limited to elementary school mathematics and related to a range of skills such as learning environment and material design, measurement and evaluation of learning outcomes, and preparing lesson plans for the school experience. On the other hand, the teaching profession courses consist of common subjects taught in all teacher education programs. The content of these courses was mainly composed of general knowledge for teaching, such as educational philosophies, learning psychology, teaching approaches. The general culture courses are taught in most departments in all universities, including all teacher education programs, while the elective courses include a limited number of ECTS courses left to the discretion of individual universities. These are generally taught according to the preferences of faculty members.

Rationale for the Study

As noted previously, comparative studies in teacher education in general, and in mathematics teacher education in particular, can provide critical information about the strengths and weaknesses of the programming offered in specified training institutions. Among some of the most significant studies carried out in this regard is the aforementioned TEDS-M project, which is a product of cooperation between 16 countries, with various universities and major institutions, including the IEA (The International Association for the Evaluation of Educational Achievement). TEDS-M made use of the conceptual frameworks, assessment tool development methods, and data analysis techniques introduced in previous studies such as MT-21 and TIMSS. As such, the TEDS-M study provides a robust set of assessment and measurement tools, including those relating to learning opportunities for pre-service teachers, that form the framework for the current study. This decision is crucial in terms of the comparability of the results generated through this research with those of the TEDS-M itself regarding opportunities to learn for pre-service teachers.

By ‘opportunities to learn’, this study refers to the learning experiences encountered by pre-service teachers within the framework of their teacher training programs that form the basis of their professional knowledge (Tatto et al., 2008). As such the study investigates the courses taken, topics covered, and experiences gained at the faculties of education with respect to mathematics, mathematics teaching, general education, and related fields. The learning opportunities offered to pre-service mathematics teachers are considered as an indicator of the quality of their training programs (Tatto et al., 2008). Therefore, by shedding light on this issue, the researchers hope to draw attention to current status of the educational policies in Turkey, a nation-state with a centralized education system, by making comparisons between universities, between the various regions of Turkey, and with the countries included in the TEDS-M project. In doing so, the study will provide valuable information for educational policymakers concerning the strengths and weaknesses of teacher education programming, as well as contributing to the theoretical discussion of comparative education and whether “it is possible to compare the education system of a state as a whole”.

In this regard, this study aims to compare the perceptions of pre-service teachers on a national and regional level about the learning experiences provided by their teacher training institutions. The study focuses on the following research question: “How do pre-service elementary mathematics teachers’ perceptions of the opportunities to learn tertiary-level mathematics/ school-level mathematics/ mathematics pedagogy/ general pedagogy offered by faculties of education vary with reference to the universities they are enrolled in and the regions in which they are located?”

Methodology

In order to compare the perceptions of pre-service mathematics teachers concerning the learning opportunities offered to them during their studies at Turkish universities, a survey design was applied with reference to the universities and respective regions of the country.

Population and Sample

At the time of data collection, 47 universities in Turkey were offering elementary school mathematics teaching programs. Therefore, the study population consisted of all senior year pre-service teachers currently enrolled in the elementary school mathematics teaching programs at these universities. The reason for the selection of senior pre-service teachers was that they had completed four years (8 semesters) of undergraduate education. Thus, it was assumed that they were better able to evaluate the learning opportunities offered to them than the students in the freshman, sophomore and junior classes.

The sample, on the other hand, originally consisted of 1431 PEMTs (with 1386 retained after the application of the data reduction procedure). These students were in their senior year at one of the 21 universities selected through layered sampling out of the larger set of 47 universities. The selection of the universities in the sample was carried out with the Nomenclature of Territorial Units for Statistics for Turkey serving as the basic point of reference. The Nomenclature of Territorial Units for Statistics (NUTS) divides Turkey into 12 Level 1 regions on the basis of a classification system reflecting the socio-economic structure of Turkey (Turkish Statistical Institute [TurkStat], 2010). Taking into account the view that education is a socio-cultural-economic concept, the classification was considered an appropriate choice for determining the universities to be included in the present study’s sample. Moreover, once the NUTS regions were defined, TurkStat announced its decision to issue all statistical data and information with reference to the said classification (Taş, 2006). Therefore, the statistical data presented with reference to this nomenclature will be influential in guiding educational policy-making in the coming years. On this basis, the present study employed the Level 1 classification. In light of the number of universities found in these regions, it can be observed that the sample represents approximately 45% of the study population. The data on pre-service teachers are summarized in Figure 1 with reference to the regions and universities included in the sample.

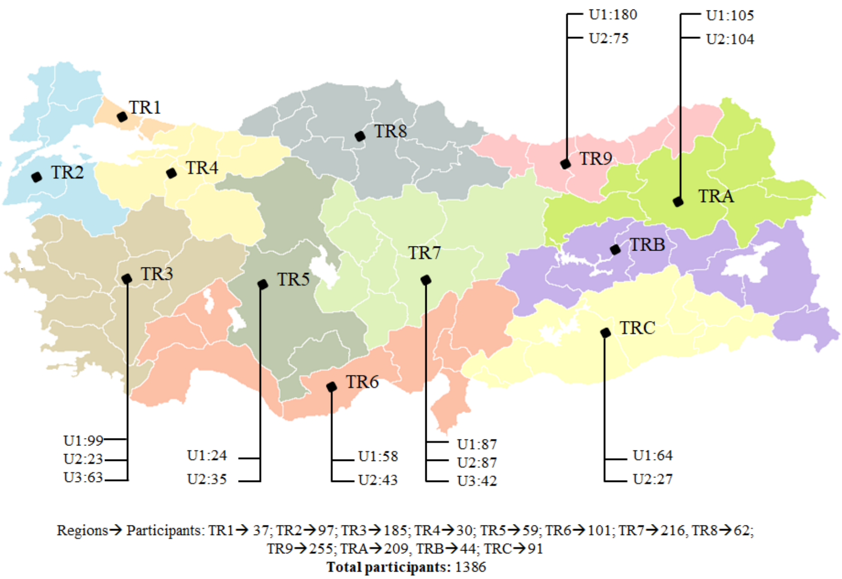

Figure 1. Distribution of the participants in terms of universities and regions

As seen in Figure 1, several of the regions in Level 1 have larger cities, such as Ankara, Istanbul and Izmir. As such, at least one of the universities selected from regions such as TR1, TR3, TR7 and TR9 was found in a city where the country's leading faculties of education are established. On the other hand, the faculties of education in smaller cities in the same regions were also included in order to create a sample that was representative of the population.

Data Collection Tools

The present study is part of a large-scale project. One of the data collection tools employed in conjunction with this project is the *"Learning Opportunities Scale"* that was used within the framework of the TEDS-M study, and for the use of which consent was obtained. In order to understand pre-service teachers' perceptions of the opportunities to learn offered by their teacher training institutions, the scales of *"opportunities to learn tertiary-level mathematics"*, *"opportunities to learn school-level mathematics"*, *"opportunities to learn mathematics pedagogy"* and *"opportunities to learn general pedagogy"* were used from among the wider set of "Learning Opportunities Scales" and adapted into the Turkish language. With these scales, learning opportunities can be explored in terms of the courses and applications offered to pre-service teachers in the institutions in which they are studying. Therefore, these scales were chosen as data collection tools for the purpose of the study.

The adaptation into Turkish and subsequent validity and reliability studies of the *"Learning Opportunities Scales"* were conducted by Aydın (2014). To adapt the scales into Turkish, linguistic validity was achieved through multiple translations and multiple revisions in accordance with the recommendations of several comparative international studies (Fleischman, Hopstock, Pelczar, & Shelley, 2010; Martin, Gregory, & Stemler, 2000; Olson, Martin, & Mullis, 2008). In this process, the English language originals of the TEDS-M learning opportunities scales (Tatto et al., 2012) were first presented to three specialists –one from the field of English Language and Literature, one from the field of Mathematics Education, and one from the field of Assessment and Evaluation– for translation into Turkish. The translations produced by these three specialists, along with the original text, were arranged in a table and presented to another faculty member, who specializes in mathematics education, for review. The feedback and revisions recommended by this specialist were also added to the table and submitted once again to the original three specialists for revision. The forms returned by the specialists were combined into a single translation, which was then was used for the validity and reliability assessments within the framework of a pilot study. Finally, taking into account the issues observed in the application of the pilot study, as well as the results of the validity and reliability analyses, the project team reviewed the assessment tools in detail, applied the necessary corrections, and developed the final versions of the scales.

The resulting *opportunities to learn tertiary-level mathematics scale* consisted of 19 items and presented pre-service teachers with the names of certain important courses and topics, such as Analytical Geometry (e.g., linear equations, curves and cones), Topology and Linear Algebra (e.g., vector space, matrix sizes, eigenvalues and eigenvectors), and asked respondents to indicate whether they had taken such courses at their respective training institutions. Similarly, *the opportunities to learn school-level mathematics scale* consisted of seven items investigating whether the pre-service teachers had been exposed to specified topics that they would have previously encountered during their studies (e.g. measurement, relation and function, equations and data representation) and that they would be required to teach in their future classrooms, in a more extensive and in-depth manner during their teacher training. The *opportunities to learn mathematics pedagogy scale* was also composed of eight items, in this case aimed at investigating whether courses such as Fundamentals of Mathematics (e.g., the philosophy of mathematics, the epistemology of mathematics and mathematics history), Mathematics Teaching Practices, Mathematics Teaching Program, and so on, which are intended to develop fundamental skills and knowledge regarding the teaching aspect of mathematics teaching knowledge, were offered within the framework of the respective teacher training programs. Finally, the opportunities to learn general pedagogy scale was composed of eight items concerning the pre-service teachers' perceptions of opportunities to learn with respect to general pedagogy courses such as History of Education and Education Systems, Philosophy of Education, Educational Psychology, Assessment and Evaluation, and so on, offered by their teacher training programs. All four of the scales used in this study presented two options, "Covered" and "Not Covered," for each item, asking the pre-service teachers to state whether or not they had been offered such experiences. Since the items in the scales were in a checklist format and did not aim to measure human behaviors, thoughts, feelings, or personality concepts, KR-20 and KR-21 values were not calculated (Cohen, Swerdlik, & Phillips, 1996).

Data Analysis

As the four scales used in the present study were comparable in terms of their structure, a single approach was applied for the analysis of the data. The process began with the scoring of the responses offered by the pre-service teachers, assigning 1 for "Covered" and 0 for "Not Covered". The overall total for a given pre-service teacher's responses to all items in a given scale was considered as that respondent's score for the scale in question. For instance, the *opportunities to learn school-level mathematics scale* was composed of 7 items. Assuming that a given pre-service teacher answered "Covered" for 5 of the items on the scale, and "Not Covered" for the remaining 2, their score on that scale was found to be 5. The arithmetic mean of the scores from respondents for a given university was noted as that university's score for the applicable scale. The scores thus established were then converted into percentages to facilitate comparisons. For instance, assuming that the arithmetic mean of the scores the students of a given university on *the opportunities to learn school-level mathematics scale* was 5.32, as the scale was composed of 7 items, the arithmetic mean was converted to the percentage figure of 76% (5.32/7=0.76).

On the other hand, the score achieved by a given region refers to the arithmetic mean of the scores that all pre-service teachers enrolled in the universities of the region had achieved and can also be expressed as a percentage to facilitate comparison. Finally, the overall score for the whole country for a given scale was the arithmetic mean of the scores achieved by all 1386 pre-service teachers involved in the study, and this is once again expressed as a percentage. The standard deviation figures were also calculated for the scores for each university and each region, as well as the entire country, with a view to reflecting the variation between the answers provided by the students and the arithmetic mean figure.

An ANOVA test was applied to determine whether the differences observed between the NUTS regions were statistically significant. For this purpose, the groups' distribution regarding opportunities to learn was first analyzed in terms of whether it was is normal or not. Consequently, most of the groups were found to exhibit a normal distribution. Moreover, the tests for compliance with a normal distribution took into account the skew coefficient for any groups that were found to lack a normal distribution. The positioning of these coefficients in the -1 to +1 range are criteria used to support the assumption of whether the groups are normal or not (Büyüköztürk, 2009). In this context, all groups were found to have met one of the two criteria. On the basis of this finding, the ANOVA analysis was applied as a parametric test allowing for the comparison of more than 2 groups as a means to determine whether statistical variations existed between regions. If a significant difference was found between the groups, the ANOVA analysis was followed by Post-Hoc analyses. Prior to this, however, the homogeneity of the variances was examined using the Levene test. Multiple comparisons with homogeneous ($p > .05$) variances determined in the Levene test were followed by a Tukey test, whereas the ones with non-homogeneous ($p < .05$) variances were followed by a Tamhane's T2 test.

Findings

Findings on the Preservice Elementary Mathematics Teachers' Opportunities to Learn Tertiary-Level Mathematics Scale

A scale composed of a total of 19 items relating to courses offered and topics covered at the tertiary level was used to understand the opportunities available for pre-service elementary mathematics teachers (hereinafter referred to as PEMTs) to learn mathematics. The scale asked the pre-service teachers to record whether they had taken the courses and covered the topics indicated in the scale. The findings reached are presented in Table 2.

Table 2.
The PEMTs' opportunities to learn tertiary-level mathematics, with reference to their universities

University	f	$\bar{x}$	(%)	SD	SE
TRAU1	104	12.62	66.42	2.20	0.22
TRAU2	105	14.15	74.47	1.75	0.17
TRBU1	44	10.84	57.05	2.24	0.34
TRCU1	64	12.70	66.84	2.68	0.33
TRCU2	27	13.04	68.63	2.53	0.49
TR1U1	37	10.97	57.74	2.62	0.43
TR2U1	97	12.93	68.05	1.63	0.17
TR3U1	99	14.13	74.37	1.56	0.16
TR3U2	23	13.04	68.63	1.92	0.40
TR3U3	63	12.33	64.89	1.85	0.23
TR4U1	30	12.53	65.95	1.55	0.28
TR5U1	24	14.04	73.89	1.76	0.36
TR5U2	35	12.91	67.95	2.72	0.46
TR6U1	58	12.84	67.58	2.12	0.28
TR6U2	43	13.19	69.42	1.69	0.26
TR7U1	87	12.93	68.05	2.38	0.26
TR7U2	42	12.98	68.32	1.39	0.21
TR7U3	87	12.21	64.26	1.99	0.21
TR8U1	62	12.11	63.74	1.80	0.23
TR9U1	180	12.99	68.37	1.42	0.11
TR9U2	75	13.71	72.16	1.60	0.18

Table 2 reveals that, in terms of the opportunities to learn offered at the tertiary level for mathematics courses and topics, the universities involved in the study were concentrated primarily in the middle of the spectrum, at data points that were close to each other. In this respect, PEMTs from 15 universities reported having such opportunities to learn at a range of 65 to 70%, while PEMTs from just 2 universities reported a perception of the opportunities to learn tertiary-level mathematics at a rate of less than 65%. Table 2 also shows that TRAU2 and TR3U1 ranked at the top of the list of universities offering opportunities to learn tertiary-level mathematics, as attested by the views of the PEMTs. These are followed closely by TR5U1 and TR9U2. Universities TRBU1 and TR1U1, on the other hand, had the lowest rating for opportunities to learn tertiary-level mathematics. The ratings for these universities were found to be consistent with other data; and the most outstanding data points as per the views of the PEMTs were observed at TR5U2 (SD=2.72) and TRCU1 (SD=2.68).

The regional and country-wide mean ratings for the PEMTs' perceptions of the opportunities to learn tertiary-level mathematics are presented in Table 3.

Table 3.
PEMTs' perceptions of the opportunities to learn tertiary-level mathematics across regions

Regions	$\bar{x}$	(%)
TRA	13.39	70.47
TR3	13.38	70.43
TR5	13.37	70.37
TR9	13.20	69.48
TR6	12.99	68.36
TR2	12.93	68.05
Mean for Turkey	**12.92**	**67.98**
TRC	12.80	67.37
TR7	12.65	66.58
TR4	12.53	65.95
TR8	12.11	63.74
TR1	10.97	57.74
TRB	10.84	57.05

As Table 3 indicates, the country mean regarding opportunities to learn tertiary-level mathematics is roughly 68%. Six out of 12 regions ranked above the country mean, while six ranked below. The region that scored the highest rating in terms of the opportunities to learn tertiary-level mathematics was TRA, while TRB scored lowest. On the other hand, the ratings for the regions that ranked above the country mean were close together. A one-Way ANOVA test was applied to determine whether the perceptions of the opportunities to learn tertiary-level mathematics varied between regions. The results are presented in Figure 2.

	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TRA	TRB	TRC
TR1		↑	↑		↑	↑	↑		↑	↑		↑
TR2											←	
TR3							←	←			←	
TR4											←	
TR5											←	
TR6											←	
TR7										↑	←	
TR8									↑	↑		
TR9											←	
TRA											←	
TRB												↑
TRC												

One-way ANOVA result: $F(11, 1374)=11.754$, $p=0.000$

*Arrows express the group favored by variation.

Figure 2. The results of the ANOVA analysis regarding opportunities to learn tertiary-level mathematics

As illustrated in Figure 2, a significant difference was seen against region TR1 when compared to regions TR2, TR3, TR5, TR6, TR7, TR9, TRA and TRC. Moreover, a significant difference was found against region TRB in comparison to regions TR2, TR3, TR4, TR5, TR6, TR7, TR9, TRA and TRC; and further significant differences were noted between TR3 and TR7-TR8, between TR7 and TRA and between TR8 and TR9. The differences favored TR3, TRA, and TR9 respectively.

Findings on the PEMTs' Opportunities to Learn School-Level Mathematics

The opportunities to learn school-level mathematics scale, which consisted of 7 items, was used to identify the school-level mathematics learning opportunities available to PEMTs. The results obtained from their responses are given in Table 4.

Table 4.
The PEMTs' opportunities to learn school-level mathematics, with reference to their universities

University	f	$\bar{x}$	(%)	SD	SE
TRAU1	104	6.00	85.71	1.26	0.12
TRAU2	105	6.01	85.86	1.28	0.13
TRBU1	44	5.59	79.86	1.32	0.20
TRCU1	64	6.47	92.43	0.99	0.12
TRCU2	27	5.30	75.71	1.75	0.34
TR1U1	37	5.19	74.14	1.51	0.25
TR2U1	97	6.41	91.57	0.92	0.09
TR3U1	99	6.14	87.71	1.22	0.12
TR3U2	23	6.48	92.57	0.73	0.15
TR3U3	63	5.68	81.14	1.37	0.17
TR4U1	30	6.03	86.14	0.93	0.17
TR5U1	24	6.46	92.29	0.93	0.19
TR5U2	35	6.09	87.00	1.36	0.23
TR6U1	58	6.19	88.43	1.07	0.14
TR6U2	43	6.30	90.00	1.06	0.16
TR7U1	87	5.90	84.29	1.13	0.12
TR7U2	42	6.55	93.57	0.74	0.11
TR7U3	87	6.22	88.86	1.16	0.12
TR8U1	62	5.82	83.14	1.43	0.18
TR9U1	180	5.93	84.71	1.07	0.08
TR9U2	75	6.09	87.00	1.10	0.13

According to the findings, the PEMTs surveyed believed that they had very substantial opportunities to learn school-level mathematics. The PEMTs from 14 universities reported having opportunities to learn school-level mathematics at a range of 85% to 90%, while PEMTs from just 3 universities reported a perception of such opportunities at a rate of less than 80%. Moreover, TR3U2 and TRCU1 were the universities that received the highest rating in terms of opportunities to learn school-level mathematics, while TR1U1 and TRCU2 offered such experiences at the lowest, yet still substantial level. The standard deviation figures reveal that the most significant variation occurred with respect to the universities with the lowest ratings, while the universities with the highest ratings exhibited much less variation.

The regional mean scores for the PEMTs' perceptions of the opportunities to learn school-level mathematics are presented in Table 5.

Table 5.
The PEMTs' opportunities to learn school-level mathematics with reference to their regions

Regions	$\bar{x}$	(%)
TR2	6.41	91.57
TR5	6.24	89.15
TR6	6.24	89.10
TR7	6.16	87.93
TRC	6.12	87.47
Mean for Turkey	**6.05**	**86.38**
TR4	6.03	86.14
TR3	6.03	86.08
TRA	6.01	85.79
TR9	5.98	85.39
TR8	5.82	83.14
TRB	5.59	79.86
TR1	5.19	74.14

According to the responses of the PEMTs, they had been offered very high levels of opportunities to learn school-level mathematics (86.38%). In the sample, five regions ranked above the country mean, while seven ranked below. The region with the highest rating in this regard was TR2, while in a result comparable to that of opportunities to learn tertiary-level mathematics, TR1 and TRB were once again ranked among the regions with the lowest ratings, albeit with their order changed.

Moreover, in order to determine whether the PEMTs' perceptions of their opportunities to learn school-level mathematics varied among the regions, a one-way ANOVA test was carried out.

	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TRA	TRB	TRC
TR1		↑			↑	↑	↑					
TR2									←		←	
TR3												
TR4												
TR5												
TR6												
TR7												
TR8												
TR9												
TRA												
TRB												
TRC												

One-way ANOVA result: $F(11, 1374) = 4.066$, $p = 0.000$

Figure 3. The results of the ANOVA analysis regarding opportunities to learn school-level mathematics

As shown in Figure 3, the variation between the regions was lower with respect to opportunities to learn school-level mathematics as compared to the variation in opportunities to learn tertiary-level mathematics.

Findings on the PEMTs' Opportunities to Learn Mathematics Pedagogy

The findings reached through the opportunities to learn mathematics pedagogy scale, which consisted of eight items, are presented in Table 6.

Table 6.
The PEMTs' opportunities to learn mathematics pedagogy, with reference to their universities

University	f	$\bar{x}$	(%)	SD	SE
TRAU1	104	4.03	50.38	2.29	0.22
TRAU2	105	5.61	70.13	2.18	0.21
TRBU1	44	4.70	58.75	2.28	0.34
TRCU1	64	4.67	58.38	2.45	0.31
TRCU2	27	2.93	36.63	2.69	0.52
TR1U1	37	5.54	69.25	1.64	0.27
TR2U1	97	5.98	74.75	1.92	0.19
TR3U1	99	5.83	72.88	1.88	0.19
TR3U2	23	6.09	76.13	1.38	0.29
TR3U3	63	6.70	83.75	1.50	0.19
TR4U1	30	5.97	74.63	1.45	0.29
TR5U1	24	5.04	63.00	2.16	0.44
TR5U2	35	5.00	62.50	2.43	0.41
TR6U1	58	4.86	60.75	1.88	0.25
TR6U2	43	6.49	81.13	1.40	0.21
TR7U1	87	6.18	77.25	2.29	0.24
TR7U2	42	5.81	72.63	1.86	0.29
TR7U3	87	6.90	86.25	1.64	0.18
TR8U1	62	5.61	70.13	1.69	0.21
TR9U1	180	5.54	69.25	1.85	0.14
TR9U2	75	5.33	66.63	1.97	0.23

As Table 6 indicates, the PEMTs reported medium or high levels of opportunities to learn mathematics pedagogy. In this regard, the PEMTs from 10 universities believed that they had opportunities to learn mathematics pedagogy, at a rate of 65% to 75%. The university offering the highest level of opportunities to learn mathematics pedagogy, as attested by the views of the respondents, was TR7U3. Furthermore, TR3U3 and TR6U2 also scored in excess of 80%; while on the other hand, TRCU2 was the university offering the lowest level of opportunities to learn mathematics pedagogy. In comparison to other universities, TRCU2 scored very low, at just 36.63%. Taking standard deviation into account, the most significant variation as per the views of the PEMTs was also observed with this university.

The regional and country-wide mean ratings for the PEMTs' perceptions of opportunities to learn mathematics pedagogy are presented in Table 7.

Table 7.
The PEMTs' opportunities to learn mathematics pedagogy with reference to their regions

Regions	$\bar{x}$	(%)
TR7	6.40	79.98
TR3	6.16	76.98
TR2	5.98	74.75
TR4	5.97	74.63
TR8	5.61	70.13
TR6	5.55	69.42
Mean for Turkey	5.54	69.26
TR1	5.54	69.25
TR9	5.48	68.48
TR5	5.02	62.70
TRA	4.82	60.30
TRB	4.70	58.75
TRC	4.15	51.92

In terms of opportunities to learn mathematics pedagogy, the PEMTs reported an mean rating of 69.26%. Six regions scored above the mean, and 6 scored below. According to Table 7, the region that scored the highest rating in terms of opportunities to learn mathematics pedagogy was TR7, while TRC had the lowest. TR1, on the other hand was closest to the national mean, with a margin of just one per thousand. In order to test whether perceptions of opportunities to learn mathematics pedagogy varied from one region to another, a one-way ANOVA test was applied.

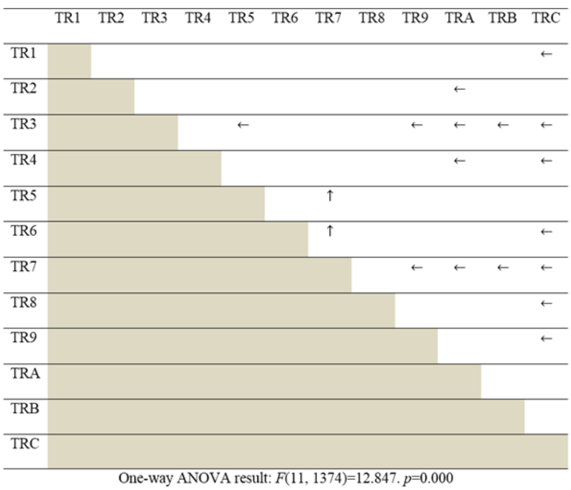

Figure 4. The results of the ANOVA analysis regarding opportunities to learn mathematics pedagogy

Figure 4 reveals a significant difference between region TR7, in comparison to regions TR5, TR6, TR9, TRA, TRB, and TRC. A further significant difference was found between region TR3 and regions TR5, TR9, TRA, TRB, and TRC, with the differences favoring TR7 and TR3 respectively. Moreover, significant differences are observed between TRC and TR2, TR4, TR8 and TR9, and between TRA and TR2-TR4. The differences are to the detriment of TRC and TRA, respectively.

Findings on the PEMTs' Opportunities to Learn General Pedagogy

The Opportunities to Learn General Pedagogy scale consisted of eight items. The findings of the scale are presented in Table 8.

Table 8.
The PEMTs' opportunities to learn general pedagogy, with reference to their universities

University	f	F	$\bar{x}$	(%)	SD
TRAU1	104	5.82	72.75	1.36	0.13
TRAU2	105	6.30	78.75	1.39	014
TRBU1	44	6.16	77.00	1.24	0.19
TRCU1	64	6.05	75.63	1.74	0.22
TRCU2	27	5.41	67.63	1.87	0.36
TR1U1	37	5.51	68.88	1.52	0.25
TR2U1	97	6.16	77.00	1.39	0.14
TR3U1	99	6.30	78.75	1.30	0.13
TR3U2	23	6.39	79.88	1.16	0.24
TR3U3	63	6.35	79.38	1.19	0.15
TR4U1	30	5.90	73.75	1.37	0.25
TR5U1	24	6.04	75.50	1.33	0.27
TR5U2	35	6.00	75.00	1.57	0.27
TR6U1	58	6.24	78.00	1.13	0.15
TR6U2	43	6.79	84.88	1.15	0.17
TR7U1	87	6.11	76.38	1.80	0.19
TR7U2	42	6.71	83.88	1.31	0.20
TR7U3	87	7.31	91.38	1.09	0.12
TR8U1	62	7.10	88.75	0.99	0.13
TR9U1	180	6.13	76.63	1.26	0.09
TR9U2	75	6.20	77.50	1.38	0.16

According to Table 8, the PEMTs indicated that they had robust opportunities to learn general pedagogy, as the PEMTs from 17 universities reported having such opportunities to learn at a rate of 75% or more, while PEMTs from just 2 universities reported a perception rate below 70%. According to the views reported by PEMTs, TR7U3 is the university offering the highest degree of opportunities to learn general pedagogy, whereas TRCU2 offered the lowest rate. The standard deviation figures reveal that TRCU2 stands out with the largest variation figure, along with the lowest level of experiences offered –albeit the variation is still small, according to the views attested by PEMTs.

The regional mean ratings for the PEMTs' perceptions of opportunities to learn general pedagogy are presented in Table 9.

Table 9.
The PEMTs' opportunities to learn general pedagogy, with reference to their regions

Regions	$\bar{x}$	(%)
TR8	7.10	88.75
TR7	6.71	83.88
TR6	6.47	80.93
TR3	6.33	79.10
Mean for Turkey	6.27	78.35
TR2	6.16	77.00
TRB	6.16	77.00
TR9	6.15	76.88
TRA	6.06	75.76
TR5	6.02	75.20
TR4	5.90	73.75
TRC	5.86	73.25
TR1	5.51	68.88

According to Table 9, pre-service teachers throughout Turkey believed that they had robust opportunities (78.35%) to learn general pedagogy. While the regions TR8, TR7, TR6 and TR3 ranked above the country means in opportunities to learn general pedagogy, the remaining eight regions ranked below mean. The region TR1, on the other hand, offered the lowest rate of opportunities to learn general pedagogy. Finally, the one-way ANOVA results showed a significant difference among some regions, as illustrated in Figure 5.

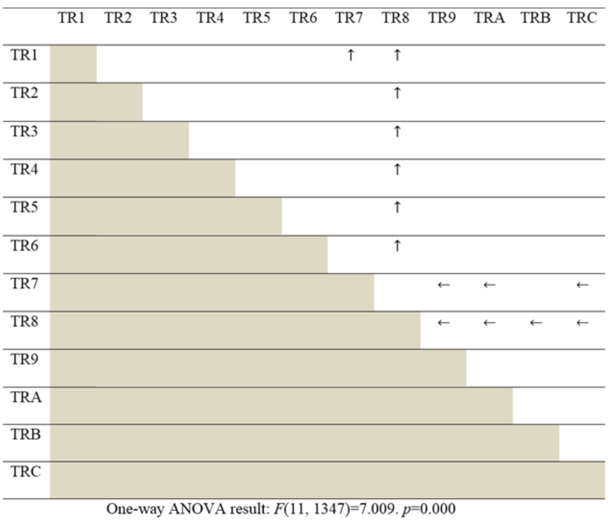

Figure 5. ANOVA findings regarding the opportunities to learn general pedagogy

A statistically significant difference was found between region TR8 and regions TR2, TR3, TR4, TR5, TR6, TR9, TRA, TRB and TRC, with the differences favoring TR8. Another statistically significant difference was observed between region TR7 and regions TR9, TRA, and TRC in favor of TR7; and yet another statistically significant difference was seen between TR1 and TR7-TR8. A review of the mean ratings reveals that the difference is in favor of TR1.

Discussion and Conclusion

The general results indicated that the PEMTs had been offered the given learning opportunities with values above the midpoint of the relevant scales. Namely, they reported that they had been exposed to opportunities to learn general pedagogy and mathematics (tertiary-level mathematics and school-level mathematics) at rates of 78% and 77% respectively. On the other hand, the mean of the learning opportunities in mathematics pedagogy (69%) was lower than the other categories. In the following section, the results obtained from Turkish universities are compared with the results obtained from TEDS-M countries.

According to the TEDS-M results, there was a high degree of variability across countries in terms of the opportunities to learn mathematics (Tatto et al., 2012). Taking the data of the 15 TEDS-M countries, Blömeke and Kaiser (2012) identified three groups of pre-service primary teachers who had similar mathematics learning opportunities during their teacher education, including advanced university mathematics, basic university mathematics and school mathematics. Although the teachers who were teaching advanced university mathematics had received the highest level of learning opportunities in mathematics, those who were teaching school mathematics had been offered the lowest level of learning opportunities in mathematics.

By this classification, Thailand and Malaysia were in the first category, while Germany and Singapore belonged to the latter. The remaining countries were included in the basic university learning category. In terms of the results for Malaysia, it may be noted that Malaysian teachers of mathematics in primary schools are trained as subject specialists (Blömeke & Kaiser, 2012). On the other hand, in countries where primary school teachers are trained as general classroom teachers (e.g., Norway and Chile), or in countries where they specialize in two subject areas (e.g., Germany and Singapore), prospective teachers typically have little opportunity to learn mathematics (Blömeke & Kaiser, 2014). As Blömeke and Kaiser (2012) report, this situation is closely related to the teacher education model of that country. With respect to the Turkish case, future elementary teachers are prepared as mathematical specialists, and thus, it is not surprising that the PEMTs from Turkey reported having more mathematics learning opportunities, as with prospective teachers from Thailand and Malaysia.

With respect to mathematics pedagogy, the TEDS-M countries showed a high degree of variability (Tatto et al., 2012). Here, there were three basic groups: broad mathematics pedagogy curriculum, functional mathematics pedagogy curriculum, and teaching methods (Blömeke & Kaiser, 2012). The teachers in the broad mathematics pedagogy curriculum category reported coverage of nearly all mathematics pedagogy learning opportunities listed on the scale. However, while the teachers in the functional mathematics pedagogy curriculum category had the opportunity to develop teaching plans, to learn about teaching methods and the school curriculum, and to observe and analyze mathematics instruction, they probably were not exposed to broader issues like the context conditions of mathematics education or affective aspects of mathematics learning. On the other hand, the teachers in the last group predominantly had the opportunity to learn about teaching methods, with little exposure to mathematics pedagogy in particular. Considering these classifications, the data from the current study place Turkey in the middle group, along with Taiwan, Singapore, and Poland. Blömeke and Kaiser (2012) claimed that this circumstance can be attributed to the educational traditions of the three Eastern TEDS-M countries (East Asia and Eastern Europe), which place value on cognitive learning in mathematics as one of the most important aspects of school programs (Schmidt, Blömeke, &Tatto, 2011). According to Baki (2018), Turkey has a similar perspective in terms of mathematics learning and the importance of mathematics for grades K-12; the present study supports this claim.

The results from the TEDS-M countries showed the greatest degree of similarity in terms of general pedagogy learning opportunities (Tatto et al., 2012). With a few exceptions (Georgia, Taiwan, Germany, Singapore), all countries are grouped under a specific profile (Blömeke & Kaiser, 2012). Future teachers from the countries in this profile reported the highest level of learning opportunities in general pedagogy. Likewise, the results obtained from Turkey also fit this profile.

In the current study, the general results indicate that PEMTs from Turkey are offered more learning opportunities in mathematics and general pedagogy than in mathematics pedagogy. This result partly concurs with the findings of Blömeke and Kaiser (2014), who noted significant variations between the opportunities to learn about mathematics, mathematics pedagogy, and general pedagogy among TEDS-M countries. For instance, the PEMTs in Germany, Poland, Russia, Georgia, Taiwan, Oman, and Thailand had more opportunities to learn mathematics than mathematics pedagogy and general pedagogy. In contrast, teacher education in Norway, the US, Chile and Botswana places a reportedly greater emphasis on pedagogy. In this sense, it can be said that the first group of countries is more focused on content, whereas the second group focuses on the teaching of content (Blömeke & Kaiser, 2014). However, the results of the present study imply that Turkey does not fall clearly into either of these groups, which can be considered as a reflection of the teacher education programs' view of teaching knowledge for mathematics in Turkey. Existing practices waver between the traditional perspective that focuses on content in mathematics teacher education and the innovative movements that emphasize mathematics pedagogy. Moreover, the final arrangements made in the context of mathematics teacher education programs in Turkey in 2018 (CHE, 2018) do not promise a remedy for this situation, as mathematics pedagogy courses will remain as electives.

Thus far in this section, the overall results obtained from the TEDS-M countries and Turkey have been discussed comparatively. Next, the results obtained from the various regions of Turkey will be compared. In this respect, the results reveal that the PEMTs' views about learning opportunities differ in terms of the regions at the NUTS Level 1. Namely, the low level of variation was observed among the regions in terms of the tertiary-level mathematics, but a high level of variation in terms of the mathematics pedagogy. It was also seen that there was a high level of homogeneity in opportunities to learn school-level mathematics among the regions. Overall, this homogeneity in terms of opportunities to learn mathematics is an indicator that the CHE framework (CHE, 2007, 2015) for teacher education has created a level of standardization. Moreover, considering general pedagogy learning opportunities, the similarity between regions is remarkable, as with mathematics learning opportunities. In terms of general pedagogy learning opportunities, the means of the regions (except TR8 and TR7) were close; while twelve of the fourteen significant differences between regions appeared in favor of these two regions when compared to the others.

According to the results of the current study, the PEMTs perceived that they had fewer opportunities to learn about mathematics pedagogy than about mathematics or general pedagogy. Furthermore, the variations between regions were most pronounced in mathematics pedagogy. This result is not surprising in the Turkish context, where the dominant idea of mathematics teacher education in Turkey until the fundamental reform movement in 1997 held that knowing mathematics was sufficient to teach mathematics (Baki, 2018). As a result of that approach, mathematics courses had an important place in teacher education programs, followed by general pedagogy courses (CHE, 2007). With the growing perception that mathematics pedagogy is an important component of teaching knowledge for mathematics (Baki, 2018; Ball, Thames, & Phelps, 2008; Fennema & Franke, 1992), this topic has found its way into teacher education programs following the 1997 reform. However, the results of this study show that this paradigm shift, which occurred approximately 20 years ago, has not yet been fully reflected in teacher education practices. One of the most important factors in the accruing of such a change in practice is the perspectives of teacher educators; in this regard, it can be said that specialization areas (i.e., field specialist vs. field education specialist) have an important place in shaping the focus of teacher education.

With respect to the means related to opportunities to learn mathematics pedagogy, the top two regions (TR7 and TR3) and the bottom two regions (TRB and TRC) are quite different from the other regions in terms of their means. Given Blömeke and Kaiser's (2012, 2014) assertion that teacher educators play a major role in providing opportunities to learn, in order to understand the reasons for this difference, the profiles of the teaching staff in the Elementary School Mathematics Education Departments of the universities were reviewed in detail. More than half of the teacher educators in the top two regions were field education specialists, while one third and one fourth of the teacher educators in the bottom two regions (TRB and TRC) respectively were field education specialists. From this point of view, it may be considered that there is a positive relationship between the number of field education specialists and the opinions of PEMTs on the mathematics pedagogy learning opportunities. On the other hand, in the TRA region, with an mean lower than Turkey's national mean, nearly half of the teacher educators were field education specialists, whereas in TR6 (with an mean very close to the national mean), the number of field education specialists was very small compared to the number of field specialists. This suggests that the differences that emerged among the regions cannot be explained by quantity alone; rather, it may also be related to the dominant culture in teacher education across regions/universities, as well as the quality of the available teacher educators. The effects of these factors in the current differentiations may be examined through future qualitative studies.

In Blömeke and Kaiser's (2012) study, it was concluded that heterogeneity in terms of learning opportunities increased when the number of teacher education institutions/programs in a country likewise increased. In their case, even if the country involved has adopted certain fundamental principles and a draft program for teacher training, the universities still have some room for interpretation for implementing the program within the framework of the wider vision. A similar circumstance is in effect in Turkey, as well. In this sense, although a draft curriculum developed by the CHE is in operation, individual faculties are granted the option to offer electives at approximately 25% of the overall credit requirement. Thus, the variation may align with a given faculty's emphasis on mathematics versus mathematics pedagogy courses as electives, as it is thus possible for each faculty to offer differing perspectives and degrees of learning opportunities.

In comparing the means of regions in terms of types of learning opportunities with the Turkish national mean, five categories emerged: (1) an upper group that was above the national mean on four scales (TR6); (2) a weighted upper group that was above the national mean on three of the four scales (TR2, TR3, TR7); (3) a middle group (TR5, TR8); (4) a weighted lower group that was below the mean of Turkey on three of the four scales (TR4, TR9, TRA, TRC); and a lower group that was below the national mean on all scales (TR1, TRB). With the exception of East Marmara (TR4) and Istanbul (TR1), the regions that have a high level of socio-economic development were included in the upper or weighted upper group; while the regions that have a low level of socio-economic development were included in the lower group or the weighted lower group. Moreover, the university surveyed in the Istanbul region was the only one with a teacher education program that differs from the CHE framework. Accordingly, the results obtained from this region must be discussed in the context of this university specifically.

Overall, it can be inferred that there is generally a positive relationship between development level of a regions and pre-service teachers' learning opportunities. On the other hand, in some cases substantial differences in learning opportunities were observed between universities in a given region. For instance, while TRCU1 was rated highest in terms of opportunities to learn school-level mathematics, TRCU2, from the same region (Southeast Anatolia), was rated lowest. Therefore, for the purposes of comparing the opportunities to learn provided to PEMTs, NUTS Level 1 should be accompanied with reference to the number of academic staff members at the universities, their areas of specialization, and the courses offered at the respective faculties in order to form more concrete conclusions in this regard.

Finally, the results of the current study reveal that certain universities and certain regions rank at the top in terms of the opportunities to learn. Given this circumstance, the classroom practices and other variables (e.g., university entrance exam scores of the students, students' expectations, student satisfaction, and so on) of the high-ranking universities and regions should be reviewed in depth and compared against those of the lower-rated universities and regions to shed light on the reasons for the variations. Doing so may allow for the identification of successful models, which could support the development of similar practices at other teacher training faculties.

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References

Aldemir, A. Y. (2010). *Türkiye ve Japonya'da İngilizce öğretmeni yetiştirme sistemlerinin karşılaştırılması.* [The comparison of English language teacher training systems in Turkey and Japan]. (Unpublished Master's Thesis), Balıkesir University, Turkey.

Aydın, S. (2014). *İlköğretim matematik öğretmeni adaylarının öğretme bilgilerinin, inanışlarının ve öğrenme fırsatlarının üniversiteler ve TEDS-M sonuçlarına göre karşılaştırılması* [The comparison of the knowledge of mathematics for teaching, beliefs and learning opportunities of preservice elementary mathematics teachers among universities in terms of TEDS-M results]. (Unpublished doctoral dissertation). Karadeniz Technical University, Trabzon

Baki, A. (2018). *Matematiği öğretme bilgisi* [Knowledge for teaching mathematics]. Pegem Akademi: Ankara.

Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching:

What makes it special? *Journal of Teacher Education,* 59(5),389–407.

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U, Krauss, S., Neubrand, M. & Tsai, Y. M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal, 47*(1), 133-180. doi: 10.3102/0002831209345157.

Blömeke, S. (2012). Content, professional preparation, and teaching methods: How diverse is teacher education across countries?. *Comparative Education Review, 56*(4), 684-714.

Blömeke, S. (2014). Framing the enterprise: benefits and challenges of international studies on teacher knowledge and teacher beliefs—Modeling missing links. In S. Blömeke, F. J. Hsieh, G. Kaiser & W. H. Schmidt (Eds.), *International Perspectives on Teacher Knowledge, Beliefs and Opportunities to Learn* (pp.3-18). London: Springer.

Blömeke, S., & Kaiser, G. (2012). Homogeneity or heterogeneity: Profiles of opportunities to learn in primary teacher education and their relationship to cultural context and outcomes. *ZDM – The International Journal on Mathematics Education. 44*, 249-264.

Blömeke, S., &Kaiser, G. (2014). Theoretical framework, study design and main results of TEDS-M. In S. Blömeke, F. J. Hsieh, G. Kaiser and W. H. Schmidt (Eds.), *International Perspectives on Teacher Knowledge, Beliefs and Opportunities to Learn TEDS-M Results* (pp. 19-47). London: Springer.

Blömeke, S., Suhl, U., Kaiser, G. & Döhrmann, M. (2014). Family background, entry selectivity and opportunities to learn: What matters in primary teacher education? An International Comparison of Fifteen Countries. In S. Blömeke, F. J. Hsieh, G. Kaiser and W. H. Schmidt (Eds.) *International Perspectives on Teacher Knowledge, Beliefs and Opportunities to Learn TEDS-M Results* (pp. 327-353). London: Springer.

Bütüner, S. Ö., & Güler, M. (2017). Gerçeklerle yüzleşme: Türkiye'nin TIMSS matematik başarısı üzerine bir çalışma [Facing the reality: A study on TIMSS mathematics achievement of Turkey]. *Bayburt Eğitim Fakültesi Dergisi, 12*(23), 161-184.

Büyüköztürk, Ş. (2009). *Sosyal bilimler için veri analizi El Kitabı* [Data analysis handbook for social sciences]. 10th ed. Ankara: Pegem Yayıncılık.

Council of Higher Education [CHE] (2007). *Öğretmen yetiştirme ve eğitim fakülteleri 1982 – 2007* [Teacher training and education faculties 1982-2007]. Ankara: Yükseköğretim Kurulu.

Council of Higher Education [CHE] (2015). *Bologna süreci* [The Bologna process]. Retrieved from http://www.yok.gov.tr/web/uluslararasi-iliskiler/bologna-sureci;jsessionid=DBF374211678275F34B7EC1B64042FC4 (10 May 2015).

Council of Higher Education [CHE] (2018). *Öğretmen yetiştirme lisans programları*

[Teacher education undergraduate programs]. Ankara: Yükseköğretim Kurulu.

Cohen, R. J., Swerdlik, M. E., & Phillips, S. M. (1996). *Psychological testing and assessment: An introduction to tests and measurement* (3rd ed.). Mountain View, CA, US: Mayfield Publishing Co.

Coşkun, H. (2009). Türkiye ve Almanya'da yabancı dil öğretmeni yetiştirme programlarının karşılaştırılması. [Comparison of the programs for training of foreign language teachers in Turkey and Germany]. *Cumhuriyet University Journal of Social Sciences, 33*(1), 61-73.

Erbilgin, E., & Boz, B. (2013). A comparison of mathematics teacher training programs in Turkey, Finland, Japan, and Singapore [in Turkish]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi [Hacettepe University Journal of Education]*, Special issue (1), 156-170.

Ergun, M. & Ersoy, Ö. (2016). Comparison of primary teacher education systems in the Netherlands, Romania and Turkey. *Kastamonu Universitesi Kastamonu Egitim Dergisi, 22*(2), 673-700.

Fennema, E., & Franke, M. L. (1992). Teachers knowledge and its impact." In D. A. Grouws (Ed.), *Handbook of Research on Learning and Teaching Mathematics* (pp. 147-164). New York: Macmillan.

Fleischman, H. L., Hopstock, P. J., Pelczar, M. P. & Shelley, B. E. (2010). *Highlights from PISA 2009: Performance of US 15-Year-Old Students in reading, mathematics, and science literacy in an international context* (NCES 2011 -004). National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Grek, S. (2009). Governing by numbers: the PISA 'effect' in Europe. *Journal of Education Policy, 24*(1), 23-37.

Hill, H. C., Rowan, B., & Ball, D. L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal, 42*(2), 371-406. doi: 10.3102/00028312042002371.

Kalkanlı, P. (2009). *Türkiye ile Fransa yükseköğretim sistemlerinin eğitim fakülteleri ile üniversite öğretmen yetiştirme enstitüleri (Mesleki eğitim dışı) bağlamında karşılaştırmalı olarak incelenmesi.* [A comparative study of Turkish and French higher education systems in the context of faculties of education and institutes for teacher training]. (Unpublished Master's Thesis), Yeditepe University, Turkey.

Kleickmann, T., Richter, D., Kunter, M. Elsner, J., Besser, M., Krauss, S. & Baumert, J. (2013). Teachers' content knowledge and pedagogical content knowledge the role of structural differences in teacher education. *Journal of Teacher Education, 64*(1), 90-106. doi: 10.1177/0022487112460398.

Küçükoğlu, A., & Kızıltaş, E. (2012). A comparison of preschool teacher training programs in the UK, Germany, France, Italy, Russia and Turkey. *Elementary Education Online, 11*(3), 660-670.

Lloyd, G. M., & M. Wilson. (1998). Supporting innovation: The impact of a teacher's conception of function on his implementation of a reform curriculum. *Journal for Research in Mathematics Education, 29*(3), 248-274. doi: 10.2307/749790.

Knodel, P., Windzio, M., & Martens, K. (2014). Introduction: Outcomes and Actors' Reactions on Internationalization in Education Policy—A Theoretical Approach. In *Internationalization of Education Policy* (pp. 1-34). Palgrave Macmillan: London.

Martin, M. O., Gregory, K. D., & Stemler, S. E. (Eds.) (2000). *TIMSS 1999 technical report.* Chestnut Hill, MA: Boston College.

Olson, J. F., Martin, M. O., & Mullis, I.V.S. (Eds.) (2008). *TIMSS 2007 technical report.* Chestnut Hill, MA: Boston College.

Schmidt, W. H., Blömeke, S., & Tatto, M. T. (2011). *Teacher education matters. A study of the mathematics teacher preparation from six countries.* New York: Teacher College Press.

Schmidt, H. W., Tatto, M. T., Bankov, K., Blömeke, S., Cedillo, T., Cogan, L., Han, S. et al., (2007). *The preparation gap: Teacher education for middle school mathematics in six countries.* Michigan: Michigan State University Center for Research in Mathematics and Science Education.

Stein, M. K., Baxter, J. A., & Leinhardt, G. (1990). Subject-matter knowledge and elementary instruction: A case from functions and graphing. *American Educational Research Journal, 27*(4), 639-663.

Taş, B. (2006). Adaptation process to the European Union(EU) for Turkey's new region concept: the nomenclature of territorial units for statistics (NUTS) *Afyon Kocatepe University Journal of Social Science, 8*(2), 185-198.

Tatto, M. T., Schwille, J., Senk, S. L., Ingvarson, L., Rowley, G., Peck, R., Bankov, K., Rodriguez, M., & Reckase, M. (2012). *Policy, practice, and readiness to teach primary and secondary mathematics in 17 countries. Findings from the IEA Teacher Education and Development Study in Mathematics* (TEDS-M). Amsterdam: IEA.

Tatto, M. T., Schwille, J., Senk, S., Ingvarson, L., Peck, R., & Rowley, G. (2008). *Teacher Education and Development Study in Mathematics (TEDS-M): Policy, practice, and readiness to teach primary and secondary mathematics. Conceptual framework.* East Lansing. MI: Teacher Education and Development International Study Center, College of Education, Michigan State University.

Turkish Statistical Institute [TurkStat] (2010). *Bölgesel sınıflandırmalar [Regional indicators].* Ankara: Türkiye İstatistik Kurumu Matbaası.

van Dooren, W., Verschaffel, L. & Onghena, P. (2002). The impact of pre-service teachers' content knowledge on their evaluation of students' strategies for solving arithmetic and algebra word problems. *Journal for Research in Mathematics Education, 33*(5), 319-351. doi: 10.2307/4149957.