DOCUMENT RESUME

ED 445 907 SE 063 964

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TITLE	A Comparative Study of the United States, Turkey, and Korea: Attitudes and Beliefs of Preservice Mathematics Teachers toward Mathematics, Teaching Mathematics, and Their Teacher Preparation Programs.
PUB DATE	1999-00-00
NOTE	13p.; Paper presented at the Annual Meeting of the Association of Mathematics Teacher Educators (Chicago, IL, January, 1999).
PUB TYPE	Reports - Research (143)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Cross Cultural Studies; Foreign Countries; Higher Education; Mathematics Teachers; Preservice Teacher Education; *Preservice Teachers; Secondary Education; *Teacher Attitudes
IDENTIFIERS	South Korea; Turkey; United States

ABSTRACT

Personal factors such as knowledge, beliefs, and attitudes are considered significant in determining not only how teachers teach, but also how their students learn. Preservice teachers' beliefs and attitudes also play an important role in their learning to teach. With the consideration of the crucial role of personal beliefs and attitudes in learning and teaching, this research examined the implications for teacher educators of prospective teachers' beliefs and attitudes toward mathematics, teaching mathematics, and their teacher preparation programs in three countries--the United States, Turkey, and Korea. In this study, 106 preservice teachers in three countries responded to a questionnaire that consisted of 35 questions. Responses to the questionnaire were analyzed using the research statistical program SPSS. Findings included perceptions of preservice teachers and differences between countries. The results of this study provide insight for teacher educators for planning teacher education programs as well as understanding the needs of prospective mathematics teachers. (Contains 11 references.) (ASK)

A Comparative Study of the United States, Turkey, and Korea

Attitudes and Beliefs of Preservice Mathematics Teachers Toward Mathematics, Teaching Mathematics, and Their Teacher Preparation Programs

By Sigrid Wagner, Hea-Jin Lee, & S. Asli Ozgun-Koca

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Teachers' personal factors such as knowledge, beliefs, and attitudes are considered as significant factors in determining not only how they teach but also how their students learn. Preservice teachers' beliefs and attitudes also play an important role in their learning to teach (Borko & Putnam, 1996; Pajares, 1992; Richardson, 1996). With the consideration of the crucial role of personal beliefs and attitudes in learning and teaching, this research aimed at examining the implications for teacher educators of prospective teachers' beliefs and attitudes toward mathematics, teaching mathematics, and their teacher preparation programs.

Research Questions

This research was designed to answer two questions about mathematics preservice education.

(1) What are the beliefs and attitudes of preservice mathematics teachers toward mathematics, teaching mathematics, and their teacher preparation programs?

(2) Are there differences/similarities in the answers to the first question among preservice teachers in three countries: the United States, Turkey, and Korea?

Through this research, the authors tried to find factors affecting student teachers' beliefs and attitudes, which may shape future mathematics teachers. The results of this study provide insight for teacher educators in planning teacher education programs as well as understanding the needs of prospective mathematics teachers throughout the programs.

Research on Beliefs and Attitudes of Mathematics Teachers

The main assumption framing this study was the impact of teachers' personal beliefs and attitudes on learning and teaching. Many research findings have established that teachers' beliefs and attitudes about teaching and learning mathematics significantly affect their students' learning as well as their learning to teach. Even though there are thousands of research reports related to teachers' beliefs and attitudes, the authors of this paper have chosen three findings that address the importance of teachers' beliefs and attitudes in different contexts.

The first research suggests the degree of impact that teachers' attitudes can have on students' attitudes. In his research on teacher attitudes toward mathematics, Aiken (1972) concluded that students' negative attitudes toward mathematics may result from a lot of things such as parents' attitudes toward mathematics and repeated failure, but the most significant factor was teachers' attitudes toward mathematics.

The second research result addresses the relationship of teachers' attitudes with students' attitudes and achievement. Cross and his colleagues (1985) compared U.S. and Japanese students' and teachers' attitudes toward mathematics. The main difference in teachers' attitudes between the two countries were summarized as follows: U.S. teachers tended to attribute the lack of desired progress of their students in mathematics to students themselves, while Japanese teachers tended to attribute lack of students' achievement to the teachers' own professional limitations. The achievement of U.S. students in this study was lower than that of Japanese students. U.S. students' attitudes toward mathematics were more positive than those of Japanese students. While U.S. teachers felt that teaching mathematics is easy, Japanese teachers reviewed the task as rather difficult.

Lastly, many researchers have suggested that students come to teacher education programs with previously constructed knowledge, beliefs, and values which may be a help or a hindrance in the learning of new ides (Adler, 1991; Britzman, 1986). On the other hand, learning new ideas may not significantly affect their beliefs about theories and methods in relation to the type of instruction they will deliver (Kagan, 1992). Instead, preservice teachers' beliefs about teaching and learning seem to be derived from their own experiences as students (Holt-Reynolds, 1992). According to the *Professional Standards for Teaching Mathematics*, teachers are influenced by the teaching they see

and experience (NCTM, 1991). In other words, teachers' own experiences have a profound impact on their knowledge of, beliefs about, and attitudes toward mathematics, students, and teaching, which implies great importance for student teachers' experiences in teacher education programs.

Teacher Preparation Programs in the Three Countries

Korea. To obtain teacher certification, students graduate from a four-year degree program in an educational university or a teaching certificate program offered at a general university. The graduation credit hours of the university where data were collected ranges from 130 to 150. The university requires more than 140 semester hours which include as many as 20 courses in mathematics, more than 7 courses in educational theory, 2 courses in specific mathematics teaching methods, a four-week field experience in the junior year, and a four-week student-teaching experience in the senior year.

Turkey. To obtain teacher certification, students must graduate from a four-year degree program in an educational university or a teaching certificate program offered at a university. The graduation credit hours of the university where data were collected requires 12 – 15 core and elective courses in mathematics, one course in mathematics education methods, one semester for field experience, and other courses such as science, and educational technology. One university in the sample has three general education courses in its curriculum whereas the other has seven of them.

The United States. To obtain teacher certification, students major in mathematics in undergraduate and graduate an integrated M.Ed. program in mathematics, science, and technology education. The graduation credit hours of the university where data were collected requires to take 12 semester hours in integrated content and pedagogy, 16 semester hours field experience, student teaching, and seminars, spread over a year, and an action research project.

Table 1. Comparison of Teacher Preparation Programs

	U.S.A.	Turkey	Korea
Teacher Ed. Program	5 years	4 years	4 years
Math Credits	46 Semester Hours	45 Semester Hours	60 Semester Hours
General Education	12 Semester Hours	9 -21 Semester	21 Semester Hours

	Integrated	Hours	
Methods Courses	4 Semester Hours	3 Semester Hours	6 Semester Hours
Field Experience	2 quarters/5th year	None	1 month/junior year
Field Experience Seminars	AU: clinical course WI: weekly seminar	None	None
Student Teaching (time in school)	Full-time/1 quarter	Full-time/1 semester	1 month/senior year
Teaching Time	5-6 courses for at least 5 weeks 1 course for 7-8 weeks	Varies (could be as little as one class session)	Varies (could be as little as one class session)
Student Teaching Seminar	SP: weekly seminar	None	None
Action Research	4 Semester Hours	None	None

Table 1 shows the differences and similarities in teacher preparation programs among the three countries. The information displayed in Table 1 does not represent teacher education programs in each country, but is a summary of the programs of universities where data were collected.

Data Collection

Participants. Data were collected from 106 secondary mathematics education student teachers in 1998: 37 seniors in Korea, 49 seniors in Turkey, and 20 5th year students in the United States. All participants had finished the field experience and student teaching by June 1998.

Instruments. The questionnaire consists of two parts: questions for demographic information and attitudes and beliefs toward mathematics, the teaching of mathematics, and programs in their departments. The questions were modified from Negangard's (1991) questionnaire and reorganized with the 6-point Likert scale ranging from strongly disagree to strongly agree. The types of information the questionnaire seeks can be classified into ten categories (See Table 2). Each item includes at least 2 and at most 4 questions.

Table 2. Classification of Items

Confidence in Teaching Mathematics

Beliefs about Mathematics	
Methods Of Teaching Mathematics	Traditional Teaching
	Manipulatives
	Cooperative Learning
	Communication among Teachers
	Communication among Students
	Technology Usage
Program	Mathematics Courses
	Mathematics Education Courses
	Field Experience Courses

Results

In this paper, we present the results by group, comparing among the three countries. Thus, the following table includes descriptive data about a group of related questions from the questionnaire presented by country. Then the analysis of that group of data will be presented by comparing the data between countries through the use of ANOVA, which indicates significant differences between the countries. The last section of the table will reveal the differences between countries in detail through the use of Post-Hoc analysis.

Self-confidence in teaching mathematics and beliefs about mathematics. Although preservice mathematics teachers from all three countries have self-confidence in teaching mathematics and positive attitudes towards mathematics, U.S. preservice mathematics teachers have more self-confidence and stronger beliefs than Turkish and Korean preservice mathematics teachers. Korean preservice teachers in particular indicated that they did not enjoy teaching mathematics. The reason for this could be the enthusiasm of U.S. preservice mathematics teachers as they begin their chosen program. In Turkey and Korea students are placed in universities through a national exam, and students must list the departments in which they would like to study before taking the exam. Thus, U.S. students begin their program with more specific and determined aims. Moreover, due to having more student teaching hours the U.S. teachers can see themselves as prospective teachers, and are aware of their capabilities.

Turkish preservice teachers believe that mathematics helps people think logically and U.S. students believe that mathematics is a very worthwhile subject for every person.

Korean preservice mathematics teachers do not enjoy mathematics as well as preservice teachers do in the other two countries. We conclude that Korean preservice teachers' beliefs toward mathematics may affect their confidence in teaching mathematics.

Table 3. Analysis of students' responses for items on self-confidence about teaching mathematics and beliefs about mathematics.

	Country	N	Mean	Std. Deviation	Std. Error
Confidence	USA	20	5.1875	.6876	.1538
	Turkey	49	4.5153	.6521	.0932
	Korea	37	4.3041	.8663	.1424
	Total	106	4.5684	.7976	.0775
Beliefs *About Mathematics*	USA	20	5.4250	.4940	.1105
	Turkey	49	5.0595	.8628	.1233
	Korea	37	4.6689	.8272	.1360
	Total	106	4.9921	.8329	.0809

Beliefs about methods of teaching mathematics. In this section, results are presented with graphs displaying the means and a table illustrating which countries are significantly different from each other.

Turkish preservice teachers believe strongly that drill and practice and lecture are among the important techniques for teaching mathematics, while U.S. students disagreed with this idea of teaching mathematics (see Figure 1). Public schools constitute the majority of teaching locations in for grades 1-12 in Turkey. Because most classrooms in public schools have more than 40 students, lecturing is the most frequently used method of teaching mathematics. Therefore, Turkish preservice teachers may think that this method is one of the main and most useful methods for teaching mathematics.

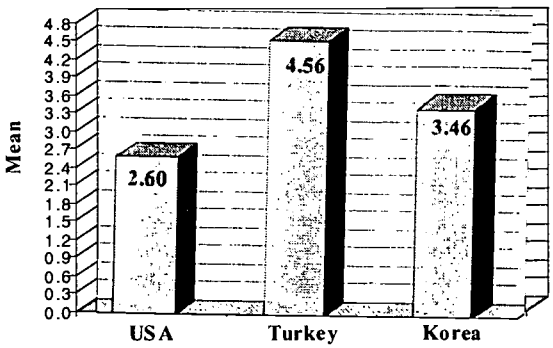

Figure 1 Traditional Teaching Methods materials

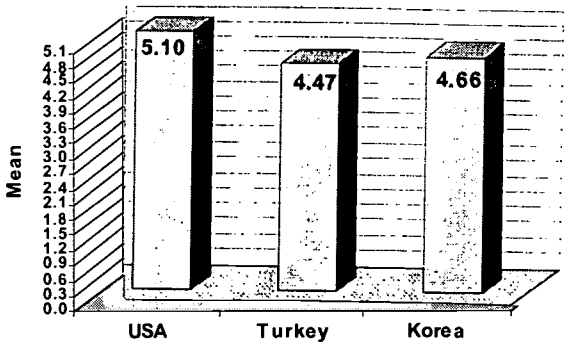

Figure 2 the Usage of Manipulative

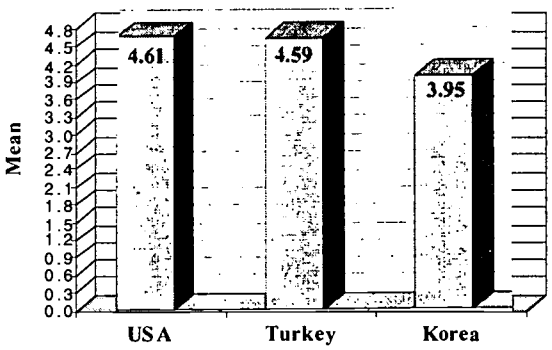

Figure 3 Cooperative Learning Teachers

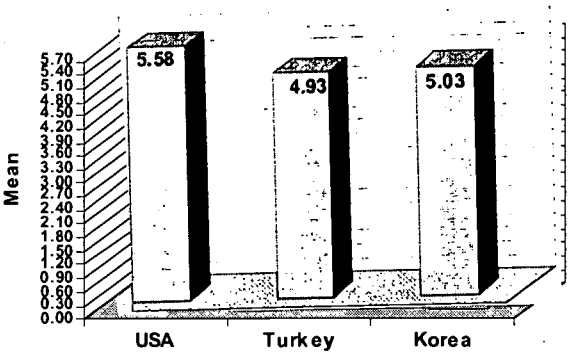

Figure 4 Communication Among

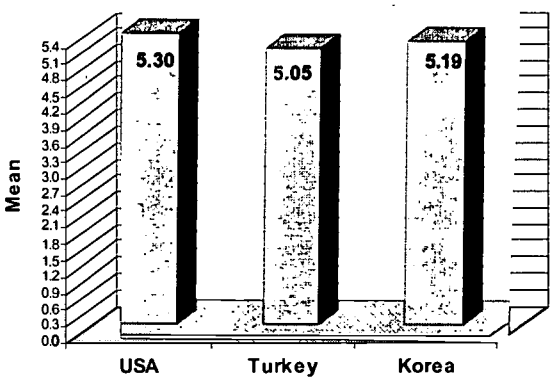

Figure 5 Communication Among Students

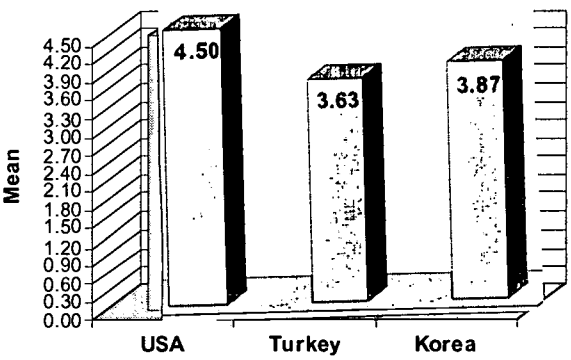

Figure 6 The Usage of Technology

Turkish and Korean preservice teachers do not believe that hands-on teaching materials are usually helpful in mathematics classrooms, while U.S. students think that teachers should use manipulative materials to demonstrate mathematics (see Figure 2). A possible explanation is that, unlike U.S. students, Korean and Turkish preservice teachers do not have experience with these materials either as a teacher or as a student.

Korean preservice teachers do not think that students understand mathematics better if they work together because they think that when students work together only one student does all the work (see Figure 3). Thus, Korean preservice teachers do not to use cooperative learning in mathematics classrooms.

Every preservice teacher in all three countries would like to share their ideas and materials for mathematics teaching with other teachers or parents in the future (see Figure 4). In particular, U.S. preservice mathematics teachers think that they can learn more important aspects of mathematics education from other teacher and parents. Every preservice mathematics teacher in all three countries strongly agreed that if students talk about mathematical ideas with other students, this will help them better understand the concept.

Table 4. Significant Differences among Countries in Issues of Teaching Mathematics

Category		Differences Between Countries		
		USA vs Turkey	USA vs Korea	Turkey vs Korea
Confidence in Teaching Mathematics		X	X	
Beliefs about Mathematics			X	X
Methods Of Teaching Mathematics	Traditional Teaching	X	X	X
	Manipulatives	X		
	Cooperative Learning		X	X
	Communication among Teachers	X	X	
	Communication among Students			
	Technology Usage	X	X	
Program	Mathematics Courses	X		X
	Mathematics Education Courses		X	X
	Field Experience Courses			X

There are significant differences in methods of teaching mathematics among preservice teachers from the three countries (see Table 4). In Turkey and Korea, preservice teachers are not exposed to constructivist classroom environments where cooperative learning and/or manipulatives may be employed. On the other hand, most of the U.S. student teachers have

more opportunities to experience and learn about these kinds of environments and their effectiveness in education. This does not mean that Turkish and Korean students are not aware of these methods or environments, but the dominance of traditional methods of teaching in their experiences brought resulted in a preference favoring for traditional methods.

Another significant difference among these countries is in the use of technology in mathematics classrooms (see Figure 6). First of all, it is forbidden to use calculators in exams or in class in Turkey and Korea. Although computers are getting into schools in Turkey and Korea; these countries are not ready to use computers in mathematics instruction. These factors can explain the significant differences in the results between the U.S. and the other two countries concerning the use of technology. Specially, Turkish and US preservice teachers agreed on the benefits of using computers in mathematics classrooms, while Korean preservice teachers did not perceive them as useful. Turkish preservice teachers have doubts about students' use of calculators in the classroom because they think that it can limit students' mathematical thinking. To Korean and Turkish preservice mathematics teachers, calculator may mean scientific calculators for computation only the authors believe that Korean and Turkish preservice mathematics teachers are not aware of graphing calculators and their capabilities in teaching and learning mathematics, and therefore may not value the use of calculators in mathematics classrooms as much as U.S. preservice teachers do.

Beliefs about program. U.S. preservice mathematics teachers think that mathematics courses required in their program provided sufficient background in mathematics (see Table 5). Turkish preservice teachers do not believe that the mathematics they learned in their program would be helpful in their future teaching. On the other hand, Korean preservice teachers do not think they can use what they learned from mathematics method courses in their future classrooms.

Table 5. Analysis of students' beliefs about their programs

	Country	N	Mean	Std. Deviation	Std. Error
MATHEMATICS COURSES	USA	20	4.3750	1.0947	.2448
	Turkey	49	3.3776	1.0795	.1542
	Korea	37	3.9369	.9776	.1607
	Total	106	3.7610	1.1084	.1077
M AT	USA	20	4.4500	.7114	.1591
	Turkey	49	4.1803	.9561	.1366

	Korea	37	3.7297	.8565	.1408
	Total	106	4.0739	.9138	.0888
FIELD EXPERIENCE	USA	20	3.5833	.5684	.1271
	Turkey	49	3.6463	.6260	.0894
	Korea	37	3.9505	.8097	.1331
	Total	106	3.7406	.6977	.0678

Although Turkish and U.S. preservice teachers value observing experienced teachers as a field experience, Korean preservice teachers do not agree. Even though the U.S. preservice teachers have more opportunities to teach than do these in the other countries, all of them agreed on the need for more teaching time in field experiences, and they believe that they need more practical and useful experiences in their field experience.

When one examines the programs, the differences in the amount of educational courses and field experience credits that U.S. students and these in the two other countries must taking is obvious. This can help us understand the lower scores for the items on beliefs about mathematics education courses in the Turkish and Korean programs.

Discussion: Factors affecting student teachers' beliefs and attitudes

1) Self-confidence and beliefs about mathematics
   - *Amount of experience in the field*: A certain amount of field experience seemed to encourage significantly deep consideration of the teaching profession as well as the value of mathematics as subject matter. Most student teachers develop or limit their self-confidence based on their success or failure in the student teaching experience. Therefore, more student teaching means greater opportunity to adjust/improve themselves as teachers.
   - *Characteristics of entering students:* As mentioned previously, students in Turkey and Korea are placed in universities through a national exam right after finishing high school, and choose their major mainly based on the exam score. In contrast, students in the U.S. begin their program with more specific and self-determined aims. Throughout the data analysis, the authors found that different characteristics of students entering teacher preparation program may affect student teachers' commitment to the teaching profession and their beliefs and attitudes toward mathematics itself.
2) Methods of teaching mathematics

- *Amount of field experience*: As discussed earlier, different amounts of field experience provide different types and depths of opportunities to encounter the teaching context. Through managing different teaching contexts, student teachers can develop criteria for determining the effectiveness of teaching materials and techniques.
- *Required course*: Even though some courses in the university are not directly related to teaching itself, the discourse and observation in the class can be good sources for learning various teaching materials and techniques.
- *Opportunities for using instructional materials and techniques:* According to research, (student) teachers' beliefs and attitudes are established based on what they experience as students. That is, various experiences provide the opportunity to determine the effectiveness of teaching methods and materials.
- *Transition from student perspective to teacher perspective*: Understanding of and judgement on the effectiveness of teaching methods seemed to differ based on who the learner and teacher may be. Therefore, it is necessary to develop perspective not only as a student but also a teacher throughout a teacher preparation program.

3) Program
   - *Program organization (amount, depth, and/or timing)*: As can be seen in Table 1, teacher education programs in the three countries have similarities and differences. The assumption that student teachers' beliefs and attitudes may result from different experiences (Holt-Reynolds, 1992) is supported by findings in this category. That is, students' beliefs and attitudes enrolled in different programs (different amount, depth, and/or timing of the courses) were distinct.

Recommendations

Regardless of the differences of context in a teacher education, teacher educators should take time to consider the following suggestions to improve professional development (pre- and inservice) as well as to better understand their students' needs in general:

- Be aware of students' needs as prospective mathematics teachers,
- Connect advanced content knowledge with knowledge needed for the classroom,
- Provide various opportunities for using instructional materials and techniques, and
- Encourage preservice teachers to reflect on what they experience as students and prospective teachers.

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