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Elementary and Secondary School Teachers' Perspectives of Effective Mathematics Teaching[1]

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This paper compares and contrasts the perspectives of effective mathematics teaching by 135 elementary school teachers, 132 middle school teachers, and 124 high school teachers using a questionnaire in South Korea. All groups of teachers chose in common the teaching and learning strand as the most important for effective mathematics instruction. However, elementary school teachers placed greater importance on the curriculum and content strand than their counterparts did. Elementary school teachers tended to agree more upon the 48 items related to good mathematics teaching than their counterparts did. The similarities and differences among the groups of teachers are expected to provoke discussion of what constitutes high-quality mathematics instruction and how such perspectives may be situated in the socio-cultural context.

Keywords: effective mathematics teaching, elementary school teachers, secondary school teacher, teachers' perspective
MESC Classification: D10
MSC2010 Classification: 97 D10

1. BACKGROUND TO THE STUDY

High-quality mathematics instruction is necessary to enhance students' mathematical learning. Therefore, many studies related to effective mathematics teaching and learning have been conducted in international contexts. What constitutes good mathematics teaching is a complex issue (Li & Kaiser, 2011; Martin, Herrera, Kanold, Koss, Ryan & Speer,

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2007; Stigler & Hiebert, 1999), partly because it is heavily influenced by educational paradigms over time. For instance, students' automatic skillfulness in solving problems, which had been emphasized in school mathematics, is less emphasized than their meaningful understanding of the important concepts or principles which underlie such problems. Thus, it is important to understand what aspects of effective mathematics teaching have been called for.

The teacher is one of the most important factors in good mathematics instruction. Several studies have made attempts to understand and to examine teacher expertise across different educational systems (e.g., Li & Kaiser, 2011). Building on such studies, this paper focuses on teachers' perspectives of good mathematics teaching. A main teaching method and its concomitant result in students' learning depend on how the teacher thinks of effective mathematics instruction (Vieluf & Klieme, 2011; Philipp, 2007). For instance, if the teacher regards students' involvement as critical to their meaningful learning, she is likely to make every effort to induce students' engagement in mathematics lessons. In another case, if the teacher prioritizes a correct answer over problem-solving processes, she is likely to emphasize the most efficient method which produces a correct answer, rather than to solicit students' divergent thinking with regard to their approach to the given problem. In this respect, teachers' perspectives on what constitutes good mathematics teaching are important.

However, previous studies of good mathematics teaching tend to focus on researchers' perspectives along with their theoretical stances and reform-based documents. Recently, several researchers turned their attention to teachers' perspectives of effective mathematics teaching. For instance, Wilson, Cooney & Stinson (2005) examined what nine high school teachers in the USA think constitute quality mathematics teaching. They found that the teachers identified sound mathematical knowledge, promotion of mathematical understanding, students' engagement with motivation, and effective management skills. More recently, Cai, Wang, Wang & Garber (2009) identified six common themes of teachers' perspectives on good mathematics teaching in different educational systems:

1. Students' active engagement,
2. Student collaboration and group activities,
3. Classroom learning environment,
4. Coherence and flexibility of the lesson,
5. Consideration of students' interests, and
6. Types of teaching.

It was reported that, despite the apparent similarity between views of teachers from various countries, subtle but significant differences existed. With regard to students' active engagement, for instance, teachers in the USA emphasized hands-on concrete activities,

while their counterparts in Australia or Hong Kong prioritized students' verbal communication. A clearer difference can be seen in the fact that Chinese teachers underscored mathematical content over such forms of involvement.

Recent studies which examine teachers' perspectives on effective mathematics instruction show that such perspectives are situated in the context of socio-cultural demands across various educational systems (Li & Kaiser, 2011). Despite the recently increased interest in Asian mathematics teachers, Korean teachers' perspectives, specifically with regard to good mathematics teaching, have rarely been studied in international contexts (c.f., Kwon & Pang, 2009), in contrast to their Japanese and Chinese counterparts. Given this background, it would be interesting to explore what Korean teachers think constitutes good mathematics teaching. This is expected to expand our understanding of teachers' views across different cultural traditions. More importantly, this study compares and contrasts elementary school teachers' perspectives of good mathematics teaching with middle-school and high-school teachers' views. This approach is different from the previous research trend of examining teachers' perspectives at the same school level. As such, this paper is intended to provoke lively discussion among the international community on how similar or different teachers' perspectives may be within and across educational systems.

2. METHODOLOGY

A questionnaire was developed to explore teachers' perspectives of good mathematics teaching. The questionnaire mainly consisted of two parts. Whereas Part II was adapted from the previous study of Kwon & Pang (2009), Part I was newly added.

Part I asked teachers to describe any aspects they regarded as important to a good mathematics lesson and aspects which they thought led to not-good lessons, along with reasons for their opinions. This was intended to induce teachers' perspectives of effective mathematics instruction in a natural way by reflecting on some mathematics lessons they had taught or observed.

Part II then asked teachers to check how much they might agree on the 48 items related to good mathematics teaching in terms of 5 Likert scales: A score of five means strongly agree and one means strongly disagree. The 48 items were categorized into 4 main domains and 7 sub-domains (see Table 1). The questionnaire additionally provided teachers with a list of domains and asked them to prioritize the domains to examine the relative importance placed on each domain. The reliability of the questionnaire was 0.9455 measured with Cronbach's Alpha.

Table 1. Overall structure of Part II of the questionnaire

Main-domain	Sub-domain	Examples of items
Curriculum & content	I. Construction of curriculum	I-1. Teaching based on the consistent, hierarchical, connected curriculum is good mathematics teaching.
	II. Selection of content	II-2. Constructing a lesson based on the essential concepts in mathematics is good mathematics teaching.
Teaching & learning	III. Teaching & learning method	III-3. Teaching basic algorithms in mathematics is good mathematics teaching.
	IV. Learner	IV-1. Motivating students is good mathematics teaching.
	V. Instructional materials	V-2. Using various materials is good mathematics teaching.
Classroom environment & atmosphere	VI. Classroom environment & atmosphere	VI-3. Teaching according to students' different mathematical abilities is good mathematic teaching.
Assessment	VII. Assessment	VII-4. Assessing students through motivated tasks is good mathematics teaching

The subjects for this study were selected by stratified cluster random sampling among Korean teachers across the country. The subjects were selected by schools. A total of 82 schools were sampled and the questionnaire was distributed through mail to 215 elementary school teachers, 215 middle school mathematics teachers, and 198 high school mathematics teachers. Note that elementary school teachers teach multiple subjects including mathematics, whereas secondary school teachers teach one subject. A total of 391 questionnaires were collected and analyzed: 135 from elementary school teachers, 132 from middle school mathematics teachers, and 124 from high school mathematics teachers.

Teachers' descriptive responses in Part I were coded by the 48 items and their frequencies were calculated. Representative responses were identified and included in the result section whenever they might provide useful information about teachers' perspectives. Several mismatching items were categorized into 'others'. The mean and standard deviation of teachers' responses on the 48 items in Part II were calculated. Given the 5 Likert scales, if the mean of an item is equal to or more than 4, it is interpreted that teachers agree with the item. One way analysis of variance was used to examine any statistical difference among the three groups of teachers. Post hoc comparisons among the three groups of teachers were made by performing Scheffe's pairwise comparisons.

3. RESULTS

3.1. Teachers' Perspective through Descriptive Response

An analysis of teachers' responses in Part I of the questionnaire showed that all groups of teachers (about 10 % of elementary school teachers, 23% of middle school teachers, and 18% of high school ones) thought in common that enhancing students' self-directed learning is good mathematics teaching. The followings are representative from each group of teachers:

- A mathematics lesson is effective when students learn by themselves mathematical principles and concepts through activities (a response from an elementary school teacher).
- A mathematics lesson that guides students to perform a mathematical task or to solve a problem for themselves, a lesson that urges students to investigate a given task and make a presentation about it, these lessons must be high-quality. I think that studying in a school is a process of learning the wisdom for life. In this respect, it is necessary for students to think over a problem by themselves and to enhance their own ability to solve such a problem (a response from a middle school teacher).
- A good mathematics lesson is the one wherein students solve a problem by themselves. This is because in the long run students need to participate in learning and play a leading role in solving a problem to enhance their ability to learn (a response from a high school teacher).

It is inferred that teachers recognized the importance of students' self-directed learning rather at the secondary school level than the elementary school level, partly because secondary students tend to participate in mathematics lesson less than elementary students do.

Whereas students' self-directed learning is the common aspect related to effective mathematics teaching among three groups of teachers, other aspects were differently emphasized among the groups. For instance, it was noticeable that as much as 20 % of elementary school teachers thought that using concrete materials is important for effective mathematics teaching. The following is an example from a description of an elementary school teacher:

- In exploring the cross section of a body of revolution, it is very useful for students to cut the section using Styrofoam and stamp it to confirm the figure of such a section. Students can learn the mathematical concept while participating in an activity with concrete materials.

Elementary school teachers' emphasis on concrete materials seems to be related to their students' developmental stage. As elementary students may have difficulty in ab-

stract thinking, the teachers thought that using manipulative materials in a mathematics teaching is important for meaningful learning.

In contrast, it was common that secondary school teachers gave priority to communication between the teacher and students. In addition, middle school teachers specifically mentioned about students' motivation and engagement, whereas high school teachers emphasized the reconstruction of a curriculum tailored to students' various mathematical abilities. The followings are an example:

- Effective mathematics teaching begins with students' interest. A mathematical content needs to be emphasized and students should be the owner of the lesson. Students' motivation and interest in mathematics are necessary to do so (a response from a middle school teacher)
- Effective mathematics teaching always considers students' levels. A mathematics lesson is a process of learning something new rather than learning a specific topic so that students' various levels should be fully considered. Simply teaching by mathematics textbooks is not a good lesson (a response from a high school teacher).

3.2. Teachers' Priority of Domains Related to Effective Mathematics Teaching

An analysis of teachers' priority of domains related to good mathematics teaching in Part II showed that the domain of teaching and learning was selected as the most important by all groups of teachers (see Table 2). It is noticeable that elementary school teachers prioritized the curriculum and content domain as much as the teaching and learning domain, whereas their secondary school counterparts mainly prioritized the teaching and learning domain. This tendency was repeated when they were asked to prioritize the 7 sub-domains (see Table 3). Elementary school teachers gave priority to the domains of 'construction of curriculum' and 'selection of content', while their middle and high school counterparts prioritized the domains of 'teaching and learning method' and 'learner' respectively. Another subtle difference of teachers' perspectives happened in the domain of classroom environment and atmosphere. A significant number of secondary school teachers chose the domain of classroom environment and atmosphere as important for good mathematics teaching, whereas only small number of elementary school teachers chose so. This tendency was also repeated when the groups of teachers prioritized both 4 main domains and 7 sub-domains of good mathematics teaching.

Table 2. Teachers' first choice among 4 main domains of good mathematics teaching

	Curriculum and content	Teaching and learning	Classroom environment & atmosphere	Assessment
Elementary	63(46.7%)	65(48.1%)	5(3.7%)	1(0.7%)
Middle	39(29.5%)	64(48.5%)	25(18.9%)	4(3.0%)
High	35(28.2%)	68(54.8%)	20(16.1%)	1(0.8%)

Table 3. Teachers' first choice among 7 sub-domains of good mathematics teaching

	Construction of curriculum	Selection of content	Teaching & learning method	Learner	Instructional materials	Classroom environment & atmosphere	Assessment
Elementary	41 (30.4%)	41 (30.4%)	23 (17.0%)	24 (17.8%)	2 (1.5%)	2 (1.5%)	0
Middle	22 (16.7%)	19 (14.4%)	36 (27.3%)	33 (25.0%)	4 (3.0%)	17 (12.9%)	0
High	25 (20.2%)	17 (13.7%)	26 (21.0%)	39 (31.4%)	3 (2.4%)	13 (10.5%)	1 (0.8%)

3.3. Teachers' Overall Perspective on Effective Mathematics Teaching

The average of teachers' responses on the 48 items in the questionnaire was at least 3.29 points up to 4.48. A total of 27 items earned more than 4.0 points, which means teachers agreed that such items reflect good mathematics teaching (see Table 4). The most agreed upon items include (a) teaching by reconstructing the curriculum according to students' various levels, (b) teaching based on mathematical communication between the teacher and students, and (c) teaching to improve students' self-directed learning ability. Note that the last item was previously confirmed by the teachers' descriptive responses in Part I of the questionnaire. The least agreed upon items include teaching by using technology and teaching students to calculate proficiently. In other words, the teachers thought that either using technology in a mathematics lesson or teaching for proficiency in calculation is not related to good teaching.

Table 4. Average score of teachers' perspectives of 48 items

Mean	Items (in descending power)
4.50 ~ 4.25	▪ teaching by reconstructing the curriculum according to students' various levels (I-4) ▪ teaching by mathematical communication between the teacher and students (VI-8) ▪ teaching to improve students' self-directed learning ability (III-16) ▪ providing students with appropriate feedback (III-13) ▪ teaching the essential concepts in mathematics (III-1) ▪ emphasizing connections among essential concepts in mathematics (III-2) ▪ teaching to improve problem-solving ability (III-8) ▪ constructing a lesson in a way to enhance mathematical processes such as communication, problem-solving, or reasoning (II-3) ▪ selecting content according to students' individual differences (II-7) ▪ motivating students (IV-1) ▪ selecting content according to students' developmental characteristics (II-5) ▪ using effective questions (III-12) ▪ considering students' aptitude and interests (IV-2)
4.25 ~ 4.00	▪ teaching to improve mathematical communication ability (III-10) ▪ teaching based on a consistent, hierarchical, connected curriculum (I-1) ▪ teaching to improve mathematical representation ability (III-11) ▪ using students' concerns (IV-3) ▪ using real-life context (III-14) ▪ selecting the content by considering students' interests (II-6) ▪ establishing a permissive classroom atmosphere (VI-10) ▪ constructing a lesson based on essential concepts in mathematics (II-2) ▪ providing students with equal opportunity based on the belief that every student can do mathematics (VI-9) ▪ constructing the content according to lesson objectives (II-4) ▪ selecting the content by considering students' knowledge and experience (II-8) ▪ teaching to improve mathematical reasoning ability (III-9) ▪ checking students' understanding by assessment at the end of lesson (VII-2) ▪ teaching basic algorithms in mathematics (III-3)
4.00 ~ 3.75	▪ using various materials (e.g., picture, photo, video, etc.) (V-3) ▪ assessing students through motivated tasks (VII-4) ▪ establishing a democratic classroom atmosphere (VI-6) ▪ using concrete materials (V-2) ▪ teaching students to know basic terms in mathematics (III-5) ▪ monitoring students' understanding by immediate assessment during a lesson (VII-1) ▪ encouraging students to solve many problems after teaching a basic concept (III-4) ▪ teaching based on a curriculum that emphasizes mathematical content (I-2) ▪ teaching to minimize students' learning deficits (III-6) ▪ teaching by appropriate grouping of students (VI-1) ▪ conducting performance assessment through real life tasks (VII-3) ▪ teaching based on a curriculum with clear learning expectations in each grade (I-3) ▪ selecting the content according to the curriculum (II-1) ▪ managing students by classroom norms (VI-4) ▪ teaching according to students' different levels (VI-3)

3.75 ~ 3.50	▪ teaching in a play format (III-15) ▪ emphasizing human relationships (VI-7) ▪ teaching while managing problematic students (VI-5) ▪ being equipped with a good physical environment (VI-2)
3.50 ~ 3.25	▪ using technology (V-1) ▪ teaching students to calculate proficiently (III-7)

3.4. Comparative Analysis among the Groups of Teachers

A comparative analysis was conducted in order to examine the similarities and the differences on effective mathematics teaching among the three groups of teachers. Figure 1 shows the average score of 48 items related to effective mathematics teaching by three groups of teachers.

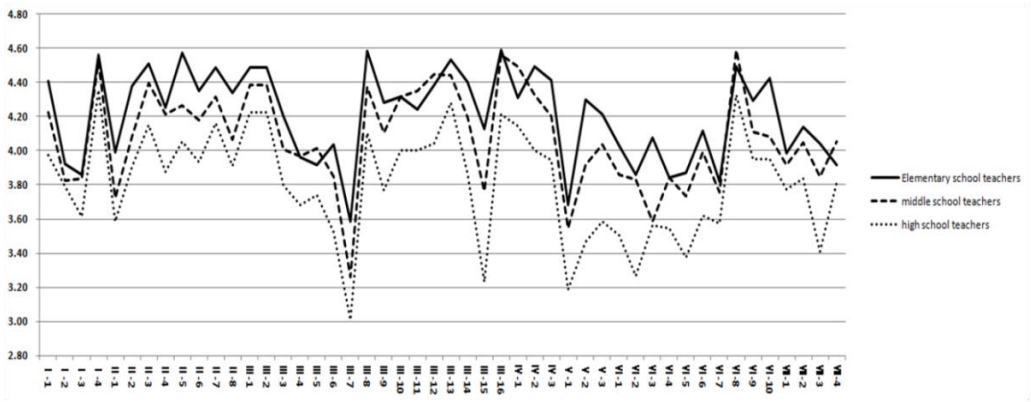

Figure 1. Average score of 48 items according to the groups of teachers

The most striking aspect in Figure 1 is the similar pattern according to the groups of teachers. Although the degree by which each group of teachers agreed upon per item was different, the overall tendency was quite similar. For instance, item II-1 (i.e., selecting the content according to the curriculum) tended to be less agreed upon within each group of teachers, whereas item III-8 (*i.e.*, teaching to improve problem-solving ability) tended to be more agreed upon. The similar pattern in the graph implies that teachers' perspectives on effective mathematics teaching were deeply entrenched in their socio-cultural contexts.

Another noticeable aspect in Figure 1 is that elementary school teachers tended to agree more than their middle or high-school counterparts did. The average scores were 4.21, 4.08, and 3.81 points according to the groups of teachers. As the school level went up, the degree by which teachers agreed upon was decreased. In fact, statistically signifi-

cant differences appeared with regard to as much as 39 items between elementary school teachers and high school teachers, and 11 items between elementary school teachers and middle school teachers as follows:

- selecting the content according to the curriculum (II-1)
- constructing a lesson based on essential concepts in mathematics (II-2)
- selecting content according to students' developmental characteristics (II-5)
- selecting the content by considering students' knowledge and experience (II-8)
- teaching students to calculate proficiently (III-7)
- teaching to improve problem-solving ability (III-8)
- teaching in a play format (III-15)
- using students' concerns (IV-3)
- using concrete materials (V-2)
- teaching according to students' different levels (VI-3)
- establishing a permissive classroom atmosphere (VI-10)

Similarly, statistically significant differences appeared with regard to as many as 29 items between middle school and high school teachers:

- teaching based on a consistent, hierarchical, connected curriculum (I-1)
- constructing a lesson in a way to enhance mathematical processes such as communication, problem-solving, or reasoning (II-3)
- constructing the content according to lesson objectives (II-4)
- selecting content according to students' developmental characteristics (II-5)
- selecting the content by considering students' interests (II-6)
- encouraging students to solve many problems after teaching a basic concept (III-4)
- teaching students to know basic terms in mathematics (III-5)
- teaching to minimize students' learning deficits (III-6)
- teaching to improve problem-solving ability (III-8)
- teaching to improve mathematical reasoning ability (III-9)
- teaching to improve mathematical communication ability (III-10)
- teaching to improve mathematical representation ability (III-11)
- using effective questions (III-12)
- using real-life context (III-14)
- teaching in a play format (III-15)
- teaching to improve students' self-directed learning ability (III-16)
- motivating students (IV-1)
- being equipped with a good physical environment (VI-2)
- using students' concerns (IV-3)
- using technology (V-1)
- using concrete materials (V-2)
- using various materials (e.g., picture, photo, video, etc.) (V-3)
- teaching by appropriate grouping of students (VI-1)

- being equipped with a good physical environment (VI-2)
- managing students by classroom norms (VI-4)
- teaching while managing problematic students (VI-5)
- establishing a democratic classroom atmosphere (VI-6)
- conducting performance assessment through real life tasks (VII-3)
- assessing students through motivated tasks (VII-4)

Specifically, (a) teaching to improve problem-solving ability, (b) using concrete materials, (c) teaching in a play format, and (d) establishing a permissive classroom atmosphere were agreed upon more by elementary school teachers than by their secondary school counterparts. Table 5 shows some examples of these differences.

Table 5. Scheffe Post Hoc comparisons among the three groups of teachers

Items	Group of teachers (I)	Group of Teachers (J)	Mean difference (I–J)	p
Teaching to improve problem-solving ability	Elementary	Middle	0.211	0.021*
		High	0.480	0.000***
	Middle	High	0.269	0.003**
Using concrete materials	Elementary	Middle	0.382	0.000***
		High	0.831	0.000***
	Middle	High	0.449	0.000***

*p<.05. **p<.01. ***p<0.001

In addition, (a) teaching students to know basic terms in mathematics, (b) teaching to improve mathematical communication ability, (c) teaching to improve mathematical representation ability, (d) motivating students, and (e) assessing students through motivated tasks were agreed upon more by middle school teachers than by their counterparts. It implies that effective mathematics teaching can be implemented in a different way in terms of school level.

4. DISCUSSION

Given that teachers' views of mathematics instruction have a significant impact on their teaching styles and ultimately students' achievement, it is important to understand the nature of their views. This study investigated Korean teachers' perspectives of good mathematics teaching. The results showed that Korean teachers perceived the importance of essential concepts and their connections in mathematics teaching. This result is aligned with the most salient characteristic of Korean classroom expertise, which is an emphasis on mathematical content (Pang, 2009). However, the teachers also thought that effective mathematics teaching includes enhancement of mathematical processes, such as problem-solving, communication, and reasoning, as well as consideration of students' individual

differences and concerns. These perspectives are influenced by the recent revisions to the mathematics curriculum in Korea, in which many characteristics of student-centered teaching methods are favored over the common teacher-centered pedagogy (Ministry of Education, Science, and Technology, 2011). However, using technology emphasized in the curriculum was not perceived as important to good mathematics teaching. Also the fluency in mathematical calculation, which had been a characteristic focus of mathematics instruction in Asia including Korea, was not perceived as particularly important.

This study also compared and contrasted teachers' perspectives of good mathematics teaching according to school levels. As noted, it is an advantage of this study, differentiating it from the previous studies examining teachers at the same school level, notably middle school teachers. A remarkable result is that different groups of teachers tend to share their perspectives on effective mathematics teaching. This implies that teachers' views on good mathematics teaching are dependent on their socio-cultural contexts (Li & Kaiser, 2011; Stigler & Hiebert, 1999). As this paper shows an overall perspective on good mathematics teaching by Korean teachers, it will be informative if further study is conducted to investigate how similar or different such perspective is in international contexts.

A final issue is related to the difference among the groups of teachers within the same socio-cultural context. In general, elementary school teachers tended to agree more than their secondary school counterparts did with regard to most items related to effective mathematics teaching. In this respect, the common themes concerning teachers' perspectives identified by previous studies across different educational systems need to be re-examined according to the groups of teachers. For instance, cultivating students' interest for effective mathematics teaching has been highlighted in common by teachers from Australia, China, Finland, Germany, Hong Kong, and the US (Cai et al., 2009). However, mainly elementary and middle school teachers in this study, not high school teachers, held a similar view of students' interest. In a similar vein, with regard to teaching to improve students' problem-solving ability, the extent to which each group thought this was significant for good mathematics teaching was statistically different. As such, the similarities and differences among the groups of teachers in this study are expected to stimulate lively discussion of what constitutes high-quality mathematics instruction within and across various educational contexts.

REFERENCES

Cai, J.; Wang, T.; Wang, N. & Garber, T. (2009). Studying effective teaching from teachers' perspectives: The journey has just begun. In: J. Cai, G. Kaiser, B. Perry & N-Y. Wong (Eds.), *Ef-*

fective mathematics teaching from teachers' perspectives: National and cross-national studies (pp. 303–317). Rotterdam, Netherlands: Sense. ME **2010c.**00041

Kwon, M. S. & Pang, J. S. (2009). Good mathematics instruction: Hearing teachers' voices. In: M. Tzekaki, M. Kaldrimidou & H. Sakonidis (Eds.), *Proceedings of the 33rd Conference of the International Group for the Psychology of Mathematics Education* "In search for theories in mathematics education", PME 33. Thessaloniki, Greece; July 19–24, 2009, Vol. 1, (p. 427). Thessaloniki, Greece: Aristotle University of Thessaloniki. ME **2014f.**00078

Li, Y. & Kaiser, G. (Eds.). (2011). *Expertise in mathematic instruction: An international perspective*. New York: Springer. ME **2011c.**00284

Martin, T. S.; Herrera, T.; Kanold, T. D.; Koss, R. K.; Ryan, P. & Speer, W. R. (2007). *Mathematics teaching today (2nd ed.).* Reston, VA: National Council of Teachers of Mathematics (NCTM) . ME **2014d.**00399

Ministry of Education, Science, and Technology [MEST] (2011). *Mathematics curriculum*. Seoul, Korea: The Author.

Pang, J. S. (2009). Good mathematics instruction in South Korea. *ZDM, Int. J. Math. Educ.* **41(3)**, 349–362. ME **2009f.**00296

Philipp, R. A. (2007). Mathematics teachers' beliefs and affect. In: F. K. Lester, Jr. (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 257–318). Charlotte, NC: Information Age. ME **2014f.**00064

Stigler, J. W. & Hiebert, J. (1999). *The teaching gap*. New York: Simon & Schuster.

Vieluf, S. & Klieme, E. (2011). Cross-nationally comparative results on teachers' qualification, beliefs, and practice. In: Y. Li & G. Kaiser (Eds.), *Expertise in mathematics* (pp. 295–325). New York: Springer. ME **2011d.**00301

Wilson, P. S.; Cooney. T. J. & Stinson. D. W. (2005). What constitutes good mathematics teaching and how it develops: Nine high school teachers' perspectives, *J. Math. Teach. Educ.* **8(2)**, 83–111. ME **2005f.**02631