

Korean Mathematics Teacher Educators' Response on the Mathematics Teaching Efficacy Beliefs Instrument

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The *Mathematics Teaching Efficacy Beliefs Instrument* is one of the most popular instruments used to measure elementary preservice teachers' efficacy beliefs in mathematics teaching. The instrument was, however, developed in the United States and is perhaps not appropriate for other cultures. In this study, the instrument was translated into Korean and carefully reviewed by Korean mathematics teacher education professors. Analysis of the review indicated that eight out of the 21 items were appropriate while the others needed to be revised. Items were identified as inappropriate due to awkwardness, multiple meanings, tense disagreements, and vagueness. These items were modified to better fit the Korean context. The instrument was revised with two versions: one for elementary and the other for secondary preservice teachers.

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KOREAN MATHEMATICS TEACHER EDUCATORS' RESPONSE ON THE MATHEMATICS TEACHING EFFICACY BELIEFS INSTRUMENT

A teacher's self-efficacy is a significant psychological construct that influences teacher instructional performances and student outcomes (Gibson & Dembo, 1984); it emphasizes the extent to which teachers believe they control, or at least strongly influence, student achievement and motivation (Tschannen-Moran, Woolfolk Hoy & Hoy, 1998). Teacher efficacy is defined as "a teacher's judgment of his or her capabilities to bring desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Hoy, 2001, p. 783). For over 30 years, educational researchers have studied teacher efficacy, which includes how it can best be measured, how it is related to other variables, such as student achievement, and the significance of it.

The nature of teacher efficacy, however, varies according to the academic discipline (Tschannen-Moran & Hoy, 2001). In fact, a teacher may have a high level of efficacy in teaching language, but a low level of efficacy in teaching mathematics. It implies that an valid and reliable instrument should be used in measuring efficacy beliefs in a specific subject matter. Teacher efficacy may vary from one culture to the next (Lin & Gorrell, 2001). In cross-cultural studies, equivalence between the source and target instrument should be carefully thought through. Data obtained from translated measures that have not been evaluated for equivalence are meaningless (Sperber, Devellis & Boehlecke, 1994). Since linguistic usage is considerably different across cultures, a word-by-word translation would not guarantee the equivalence between two different languages. When an instrument is translated from one language to another, grammatical sensitivity as well as connotative characteristics including culture, experience, syntax, and conceptual interpretation need to be considered (Wang & Lee, 2006).

The *Mathematics Teaching Efficacy Beliefs Instrument* (MTEBI) was developed in the US by Enoch, Smith & Huinker (2000). The purpose of this study was to revise the MTEBI for use in Korean context. We presume the theoretical foundation of the MTEBI, and then, by taking into consideration the cultural and linguistic components of Korea and the Korean language, address how the MTEBI can be better revised for Korean preservice teachers. The revisions were completed by having four Korean mathematics teacher education professors provide their perspectives on each item of the MTEBI. It is expected that a revised MTEBI adapted to the Korean culture will provide a more valid and reliable measure of Korean preservice teachers' personal mathematics teaching efficacy and outcome expectancy.

LITERATURE REVIEW

Bandura's social learning theory provides a theoretical framework to the study of teachers' and preservice teachers' efficacy beliefs in mathematics teaching. In his theory, Bandura (1977) defined self-efficacy as individuals' judgments of their capabilities to accomplish certain levels of performance. Perceived self-efficacy contributes significantly to level of motivation and performance accomplishment; that is, these beliefs can better predict levels of success in an individual's future behavior more than through his or her actual accomplishments (Bandura, 1997). In brief, Bandura's theory posits that an individual's future behavior can be controlled by the two variables of Self-Efficacy (or Personal Efficacy) and Outcome Expectancy. Self-Efficacy is an individual's beliefs that influence one's capability to cope with change in situated experiences, and Outcome Expectancy is a generalized expectation that influences an individual's action-outcome contingencies based on perceived life experiences.

Bandura's two dimensional model of self-efficacy was adapted into the context of education. At first, Gibson and Dembo (1984) developed the Teacher Efficacy Scale for measuring inservice teachers' sense of efficacy beliefs. This instrument consists of two subscales of Personal Teaching Efficacy and Teaching Efficacy. The first subscale, Personal Teaching Efficacy corresponds to Bandura's Personal Efficacy; the second subscale, Teaching Efficacy corresponds to Bandura's Outcome Expectancy. The Gibson and Dembo's Scale has been widely used in educational studies that verified the importance of teacher efficacy (Tschannen-Moran et al., 1998).

While Gibson and Dembo's scale measures teachers' general sense of efficacy beliefs, teacher efficacy also has been examined in a specific subject area within Bandura's stance. Teacher efficacy is now regarded as context specific and subject-matter specific (Tschannen-Moran et al., 1998). For example, Enochs and Riggs (1990) employed Gibson and Dembo's method to develop the Science Teaching Efficacy Beliefs Instrument for measuring inservice (STEBI-A) and preservice (STEBI-B) teachers' science teaching efficacy. The STEBI has the two subscales of Personal Science Teaching Efficacy and Science Teaching Outcome Expectancy. These two subscales were named with more straightforward relationship to the Bandura's two dimensions of Personal Efficacy and Outcome Expectancy. Later, Enochs, Smith, and Huinker (2000), modifying the STEBI-B, developed the Mathematics Teaching Efficacy Beliefs Instrument (MTEBI) for elementary preservice teachers. Like the STEBI, the MTEBI has two subscales of Personal Mathematics Teaching Efficacy (PMTE) and Mathematics Teaching Outcome Expectancy (MTOE).

Recently, the MTEBI has been used to explore the relationship of mathematics teach-

ing efficacy to other factors for US elementary preservice teachers. For example, mathematics teaching efficacy is positively related to mathematics methods courses and field experience (Swars, Smith, Smith & Hart, 2009; Utley, Bryant & Moseley, 2005), and mathematics instructional strategies (Swars, 2005). On the other hand, mathematics teaching efficacy is negatively related to mathematics anxiety (Gresham, 2008; Swars, Daane, and Giesen, 2006; Swars, Smith, Smith, & Hart, 2009). Those results verified the importance of preservice teachers' mathematics teaching efficacy in elementary teacher education program.

Since teacher efficacy can vary from one culture to the next (Lin & Gorrell, 2001), it is questionable whether the MTEBI, as it is currently written, can be used in other cultures. In particular, the use of the MTEBI in non-Western countries is more questionable since the culture and the language of the target country are usually very different from the US. The MTEBI has been tested in a few non-Western cultures. For example, Alkhaateb (2004) translated the MTEBI into Arabic to test it on the sample of 144 Jordanian undergraduate students majoring in elementary education. He reported that the two-factor structure on the Arabic MTEBI was constructed, and the alpha coefficients of internal consistency were 0.84 for the PMTE subscale and 0.75 for the MTOE subscale. This result verified the use of the MTEBI for Arabic speaking Jordanian people.

However, in another study, we see that the use of the MTEBI is not fully guaranteed. Ryang (2007) translated the MTEBI into Korean to test on the sample of 165 Korean mathematics education students. He obtained Cronbach alphas of 0.83 for the PMTE subscale and 0.74 for the MTOE subscale, after deleting five items. What is even worse is that the 16 item instrument (after deleting five items) did not show a valid two-factor structure. Those results indicated that the MTEBI, as it were, should not be used in a research study. As implication, the translation process did not make equivalence between the source and target language. Given the cultural influence on teacher efficacy (Lin & Gorrell, 2001), it is possible that Korean preservice teachers may have different perspectives on teaching mathematics based on different socio-cultural backgrounds. In addition, English and Korean are very different languages; therefore, researchers should consider linguistic and socio-cultural dimensions when translating the instrument from English to Korean.

METHOD

Participants

In this study, the participants were four Korean professors affiliated in a College, or University, of Education in Korea which houses mathematics teacher education program.

Each professor is either the department chair or the program coordinator of the mathematics education. Professor J is a female associate professor of elementary education; she has taught mathematics methods courses for the past 7 years. She earned Ph.D. degree in the US. Professor S is a male full professor of elementary education; he has taught mathematics content courses for the past 20 years. He earned Ph.D. degree in Korea. Professor P is a male full professor of elementary education; he taught content and method courses for the past 17 years. He earned Ph.D. degree in Canada. Professor Y is a male full professor of secondary mathematics education; he has taught statistics courses for the past 12 years. He earned Ph. D. in Korea. All four professors are fluent in reading English.

Procedure

The participants were asked to read the original MTEBI in English and then review the Korean-translated MTEBI. Interviews with the four reviewers were conducted through e-mails and one face-to-face meeting in an international conference in Korea. The reviewers were asked to check the translation and appropriate use of language of the translated MTEBI, especially the language used for mathematics teacher education in Korean classrooms. The first e-mail to the reviewers provided the review protocol including description on the MTEBI and review directions (see Appendix A). The main question given to the reviewers was: "Do you believe that each item is appropriate for measuring a preservice teacher's mathematics teaching efficacy beliefs regarding their mathematical knowledge, skills, and behavior? Why or why not?"

After reviewing the MTEBI, each reviewer was asked to give additional comments or suggestions of the other reviews. An example is shown in Appendix B. Follow-up discussions between each reviewer and the authors were completed through e-mails. One of the authors also met two of the reviewers at an international conference to discuss the reviews in person. Additional after-meeting discussions through e-mail led to final agreement on the appropriateness of each item in measuring a preservice teacher's personal mathematics teaching efficacy or students' outcome expectancy from effective mathematics teaching.

Instrument

This study employed the MTEBI which measures how confident elementary preservice teachers feel that they teach mathematics effectively. The MTEBI consists of the 13-item PMTE scale and the 8-item MTOE scale. A PMTE item represents personal beliefs about one's ability to teach mathematics effectively, and a MTOE item describes the expectancy that effective mathematics teaching will result in a positive outcome in student's mathematical learning. A PMTE item is stated in the first person and written in

the future tense since preservice teachers are not yet professional teachers while an MTOE item is stated in the third person and written in the present tense. Eight PMTE items out of the 13 items are negatively worded while All the MTOE items are positively worded (including double-negative wording). For convenience, a PMTE item was coded by the initial P with its item number, and an MTOE item was coded by the initial O with its item number (*e.g.*, P2, O9).

Translation

One of the authors along with two bilingual doctoral students, who were knowledgeable of the concept of mathematics teaching efficacy, translated the MTEBI into Korean. In translating from one language to another, it is important to conduct a back-translation to check the translation quality (Brislin, 1970). The Korean-translated MTEBI was translated back into English by another bilingual graduate student. Then, comparing the original MTEBI, the translated MTEBI, and the back-translated MTEBI led to some modifications in the Korean version MTEBI. For example, in Item P8, the adverb 'generally' was deleted since it might decrease a personal trait as a PMTE item. In Item P16, 'question' was specified by 'mathematics question.' One of the greatest challenges in instrument translation is "to adapt the instrument in a culturally relevant and comprehensible form while maintaining the meaning of the original items" (Sperber, Devellis & Giesen, 1994, p. 502). Though the translators understood the context of mathematics education in Korea, they are not experts in language/culture. Despite the exerted effort of the translators, some errors may have occurred in translation.

RESULTS

Appropriate Items

An item was considered appropriate when no changes were needed in the wording. Reviewers considered eight items (P8, P15, P16; O4, O7, O10, O12, O13) to be appropriately stated (see Table 1). While most of these items were readily agreed to be appropriate by the reviewers, some items required more discussion before an agreement was reached. For example, Professor K opined on Item P15 that the use of manipulatives is not common in a Korean classroom. Other professors responded that the item might be detected by researchers or inservice teachers, but it seems fine for preservice teachers. Professor K eventually gave an agreement. Though these items were considered as appropriate by the reviewers, some wordings in the item were discussible.

Table 1. Appropriate Items

Code	Items
O4	When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.
O7	If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.
P8	I will generally teach mathematics ineffectively.
O10	When a low-achieving child progresses in mathematics, it is usually due to extra attention given by the teacher.
O12	The teacher is generally responsible for the achievement of students in mathematics.
O13	Students' achievement in mathematics is directly related to their teachers' effectiveness in mathematics teaching.
P15	I will find it difficult to use manipulatives to explain to students why mathematics works.
P16	I will typically be able to answer students' questions.

Inappropriate Items

The reviewers agreed that the content of the items were appropriate in regard to mathematics teaching efficacy beliefs. However, they indicated that some items have both synthetic and semantic language problems when translated into Korean. Problems were identified as

- (a) awkwardness,
- (b) multiple meanings,
- (c) tense disagreement, and
- (d) vagueness.

An expression in an item is 'awkward' when the language used is contrary to a usual way of how it is expressed in Korean. Reviewers mentioned that "[wording] is okay but not often used; is understandable but not easily acceptable; is not going well with other parts," and actually "It is awkward." The problem of 'tense disagreement' occurred when a PMTE item was stated in the present tense instead of in the future tense. The problem of 'vagueness' was determined when an unclear word was used in the item statement. A reviewer stated, "[The word] is vague so the meaning of the statement is unclear." The problem of 'multiple meanings' occurred when an item could be interpreted in more than one way.

Reviewers indicated problems in the items of P2, P3, P5, P6, P11, P17, P18, P19, P20,

P21; O1, O9, O14. The reviewers not only detected the problems in the item wordings but they also suggested alternatives for those problematic items. Table 2 showed the original wordings of those items with their alternatives suggested by the reviewers. Interestingly, problematic PMTE items were mostly awkward and of multi-meaning while some MTOE items were inappropriate because of vagueness.

Items of awkwardness

It was found that negative wording is a factor to awkward wording in the Korean language. In fact, four out of the five awkward items were negatively worded. The reviewers felt that an intentionally negative wording in an item is not convenient for Korean population; in response, they suggested changing the negative wordings in the items of P3, P18, and P19 to the positive wording. Reviewers agreed that P3 and P18 would be the most problematic in the entire instrument. These two items were also interpreted in multiple ways; see the section on multiple meaning below. In Item P19, the reviewers indicated that the phrase 'at a loss' makes the whole item confusing; they suggested deleting the phrase to change to a positive wording item.

Other than the negative wording, the reviewers also had indicated that there is no proper Korean term corresponding to 'monitoring' in Item 6, which is often used without translation. The reviewers suggested 'observing' as a substitute for 'monitoring.' In Item P20, 'welcome' is not preferably used in Korean education; reviewers suggested that it would be replaced with other expressions such as 'like to answer.' In this case, the item becomes similar to Item P16 which was already considered appropriately stated. Therefore, to differentiate between these two items, Item P20 was suggested to be modified to: "I will use students' question in my mathematics teaching."

Items of multiple meanings

In Item P3, reviewers pointed out that the phrase 'other subject teachers' may have multiple meanings. Since Korean elementary teachers are all-subject (including even arts, music, and physical education) generalists, it may indicate any teachers teaching a non-mathematical lesson at the moment. That is, it may indicate elementary preservice teachers in the other further study track such as science, social studies, or language. Or, it possibly indicate secondary preservice teachers majoring mathematics education.

The reviewers initially suggested rewriting Item 18 as: "If I select people who observe my class, then I will not choose the principal" to cure the awkwardness. However, a problem still exists. The suggested alternative seems not to ask about efficacy beliefs but about one's preferences. To open the class to whoever might need to evaluate the class (without mentioning a specific person such as the principal) could work for the purpose

of measuring efficacy beliefs. Reviewers therefore suggested other statements as alternatives for Item 18. Examples include that I have no fear to open my class to others; I will teach mathematics well in an open class; I will open my class to other peer teachers or parents; I am sure of high ratings on the class evaluation.

Item P2 was indicated to show a teacher's willingness to finding better ways of mathematics teaching, rather than ability of doing so. The verb 'will' used in the item can be used as present future tense but can also include the subject's mind, intention, purpose, and desire. In this case, the item loses the goal of the instrument to show one's personal ability in mathematics teaching. Reviewers suggested that one should be careful when using the verb 'will' in order not to be clear on meaning; *i.e.*, mind, intension, purpose, or desire. Other personal efficacy items that use the auxiliary verb 'will' were carefully checked for this concern among reviewers.

Item O1 can also be interpreted in two ways. The first interpretation is that a student's doing better in mathematics is related to a teacher's extra effort in teaching mathematics. Thus, this meaning asks for a belief related to whether a teacher is a factor in having a positive effect on student learning. The item can secondly be interpreted as asking for the frequency of such an effect on a student learning. The adverb 'often' in this item is asking the responder to consider two separate classroom teaching instructions within one item. The use of an adverb indicating frequency was not suggested. Thus, a suggested alternative was that: "When a teacher exerts an extra effort in a student's mathematics learning, the student does better than usual in mathematics."

Items of tense disagreement

Since preservice teachers do not currently teach but will teach in the future, a PMTE item is required to use the future tense. However, verbs 'know' in Items P5 and P21, and 'understand' in Item P11 are unusual with the future tense in English; the present tense was used in the MTEBI. Reviewers pointed out that it violated the rule of tense for a PMTE item. In these cases, Professor J suggested using two clauses in an item, one of which uses the present tense and the other which uses the future tense; she placed 'know' or 'understand' in the subordinate clause and introduced the main clause with the future tense. Then, the revised form of, for example, Items P5 is that: "Since I know already how to teach mathematics concepts effectively, I will not need to learn more about it in the future." This statement, however, looks lengthy, compound, and even awkward; it needs further discussion. In Item P21, The reviewers were not aware of the verb 'know' possibly because 'know' was behind 'do not.'

Items of vagueness

Reviewers stated that it was not unusual to find words or short phrases in an item that were not clear due to its wider meaning than needed. In Item O9, for example, reviewers were not clear what 'background' means. This word can be understood by means of knowledge, intelligence, performance, attitude, home environment ... or all of these. Reviewers suggested using a more concrete word. For this item, the reviewers suggested 'knowledge' as a possible substitution for 'background.' In Item O14, the word 'performance' was considered vague; the reviewers suggested using, more specifically, 'mathematical performance' or 'performance in a mathematics lesson.' The reviewers also noted that including the term 'parents' in the Item O14 reduces the focus on students' interest; avoiding use of 'parents' in the item was suggested. Thus, a possible alternative is that: "When students show more interest in mathematics at school, it is probably due to the teacher's performance in a mathematics lesson."

For Item P17, the verb 'will' indicates that it is in the future when I will have the teaching skills. In the Korean translation, however, even though 'will' was translated into wording indicating the future, it comes after the main verb 'wonder'; possibly many Koreans are not aware of the tense under the subordinate clause. Professors J and P pointed out that it is not clear when such skills are acquired; for example, whether during the teacher education program or later in one's teaching career. The item might be regarded to be part of teacher professional development. Reviewers strongly suggested rewriting this item without giving an alternative.

Table 2. Inappropriate Items and Their Alternatives Suggested by Reviewers

	Item	Alternative
	Awkwardness	
^a P3	Even if I try very hard, I will not teach mathematics as well as I will most subjects.	If I work hard in mathematics material study, then I will teach mathematics well.
P6	I will not be very effective in monitoring mathematics activities.	I will not be very effective in observing students' mathematics activities during a lesson.
P19	When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.	When a student has difficulty understanding mathematics concepts, I will be able to help the student.
P20	When teaching mathematics, I will usually welcome student questions.	I will use students' question in my mathematics teaching.

Table 2 (Cont.)

Multiple Meaning		
O1	When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.	When a teacher exerts an extra effort in a student's mathematics learning, the student does better than usual in mathematics.
P2	I will continually find better ways to teach mathematics.	Not given
^a P18	Given a choice, I will not invite the principal to evaluate my mathematics teaching.	I will teach mathematics well in an open class.
Tense Disagreement		
P5	I know how to teach mathematics concepts effectively.	Since I know already how to teach mathematics concepts effectively, I will not need to learn more about it in the future.
P11	I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	Since I understand mathematics concepts well, I will teach mathematics effectively in the future.
^b P21	I do not know what to do to turn students on to mathematics.	Not given
Vagueness		
O9	The inadequacy of a student's mathematics background can be overcome by good teaching.	A student's lack of mathematics knowledge can be overcome by good teaching.
O14	If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	When students show more interest in mathematics at school, it is probably due to the teacher's performance in a mathematics lesson.
P17	I wonder if I will have the necessary skills to teach mathematics.	Not given

Note. ^aItems P3 and P18 were problematic for both awkwardness and multiple meanings.
^bReviewers were not aware of the tense disagreement in Item P21.

DISCUSSION

Personal Efficacy Wording (will be able to)

Reviewers not only suggested alternatives for the inappropriate items but they also suggested new items of personal mathematics teaching efficacy beliefs. Examples include items:

- I will be able to give an answer for any mathematical questions from students.
- I will be able to teach students to easily understand mathematics.
- I will be able to explain a complex mathematical concept in a brief and easy manner;
- I will be able to explain mathematics easily to students who think of mathematics as being difficult.
- I will be able to get a student of any achievement level to have a successful experience in mathematics learning and to have a happy life.

Those items are all positively worded and include auxiliary verbal phase will be able to which shows the future tense and indicates ability of the action of the verb following. Some items in the instrument were discussed as asking willingness (P2), preference/intention (P18), or frequency (O1), rather than ability. Use of 'will be able to' — 'will be unable to' for the negative wording — within the verbal phase in the item can possibly avoid those different interpretations.

The use of "will be able to" also help to solve the problem of tense disagreement. In order to correct the problem of tense disagreement, reviewers suggested to introduce a composed sentence where the main clause is future tensed though the subordinate clause is present tensed. According to this suggestion, Items P5 and P11 were restated. For example, Item P5 was revised to: "Since I know already how to teach mathematics concepts effectively, I will not need to learn more about it in the future." However, the suggested alternative seems rather awkward in that different tenses are used in one sentence, and the meaning of the item is changed much. The reworded item, by using 'will be able to' in the verbal phase, would solve these problems: "I will be able to know how to teach mathematics concepts effectively." Likewise, Item P21 will be: "I will be unable to know what to do to turn students on to mathematics." Reviewers suggested checking carefully the use of 'will' in verbal phase in all PMTE items. We saw that the use of 'will be able to' is a way to cure the problems the reviewers concerned. At this point, we propose to use "will be able to" in all PMTE items.

MTOE Item Wording (if-then with positive)

A reviewer found a possibility of logical misunderstanding on if-then statement of an MTOE item. Suppose a conditional statement theoretically assumed: If p , then q . We know that only contrapositive form, if $\sim q$, then $\sim p$ is logically equivalent to the original statement; the converse is not equivalent to the original item statement. Professor P recognized some of MTOE items were neither in the conceptual if-then form nor its contrapositive. Rather, they were in the converse form. However, his argument was not fully agreed by other reviewers. Some items were considered as appropriate, others problematic. Nonetheless, It-then structure is valuable to discuss here; must be considered in revising the MTOE items.

The theoretical assumption of the MTOE variable is that if mathematics teaching is effective, then student mathematical outcome is better. Most MTOE items were worded in a conditional statement (if-then structure) using this theoretical assumption. The converse assumes that students' better performances in mathematics come from effective mathematics teaching. The converse is not fully true because a student's mathematics outcome is not a single variable function of effective mathematics teaching; it might measure only limited sense of mathematics teaching efficacy. In this respect, Items O1, O10, and O14 were considered to be converse. See, for example, Item O1: "When a student does better than usual in mathematics, it is often because the teacher exerted extra effort." This item has the if-then structure. The if-clause (in this item, when-clause) includes a student's doing mathematics better than usual, and the then-clause includes a teacher's extra effort. This form opposes the premise that the assumption of effective teaching leads to the conclusion of better outcome. Interchanging the if-clause and the then-clause will give a logical structure on the item.

However, other reviewers liberally regarded this item as acceptable because of the adverb 'often.' By using this adverb, a reader will admit that students' better outcome is not always due to a teachers' extra effort, and can conclude that it might be true. In addition, the adverb 'often' can influence the strength of beliefs on the item since the degree of 'often' is slightly different from individual persons. We need to be careful for such an adverb showing frequency or degree such as 'very' in Items P3 and P6, 'often' in Items O1 and O4, 'most likely' in Item O7, 'generally' in Items P8 and O12, 'usually' in Item O10, 'directly' in O13, 'probably' in Item O14. A suggest here is to avoid using those adverbs in the items.

In addition, the contrapositive form has negative wordings in both the if-clause and the then-clause, which violates the positiveness of assumption (effective teaching) in the if-clause. Though double negations in the contrapositive form can give the logical equivalence with the original statement, it perhaps makes a psychological difference in Korean

peoples' minds. Double negations are awkward for Koreans. If an item is written in the form of contrapositive of the theoretically assumed form, we suggest using the original form, instead. For example, Item O7 (If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching) is selected as one of appropriate items. However, we consider using its logically equivalent form with no negation: "If a teacher's mathematics instruction is effective, then students have good achievement in mathematics."

The if-then structure is considered as conveying the theoretical assumption of expectancy to students' mathematical learning outcome. However, three MTOE items (O9, O12, O13) were not stated with the if-then structure; those items are suggested to restate using the if-then structure with the same context. Therefore, Item O9 is restated as "If a teacher gives effective mathematics teaching, then inadequacy of a students' mathematical performance can be overcome"; Item O12 is restated as "If a teacher takes responsibility for student learning, then the students' mathematics achievement will improve."; and Item O13 is restated as "If a teacher teaches mathematics effectively, then students' achievement in mathematics is improved."

Negative Wording

Eight items (P3, P6, P8, P15, P17, P18, P19, P21) were negatively worded in the PMTE scale. Among them, six items (P3, P6, P17, P18, P19, P21) were considered by the reviewers to be inappropriate. Two items were negatively worded by using verbs 'wonder' (P17) and 'do not know' (P21); the other four items became negative with the form 'will not' plus a verb, i.e., 'will not teach' (P3), 'will not be very effective' (P6), 'will not invite' (P18), 'will be at a loss' (P19). Those four items were found to have the same problem of awkwardness. These observations indicate that Koreans like to use positive wording rather than intentionally negative wording. In the case of expressing negative wording, Koreans prefer one single negative word to two-word negative form. For example, Item P21 had negative form of wording, 'do not know,' but in the Korean translation it would be changed to a single Korean word 'moruda' meaning 'do not know.' These findings support that word-by-word translation of negative wording in English into Korean can make the statements awkward.

Before the translation of the MTEBI into Korean, one of the authors, a US mathematics education professor, expressed concern regarding the negative wording in some of the items, and suggested changing the wording from the negative to the positive in the items of P8, P17, and P19. In general, he felt using too many negative statements (such as P8) possibly could make the instrument negatively biased. He also suggested changing the verb 'wonder' in Item P17 and 'at a loss' in Item P19 to positive wording. In order to

minimize changing the original MTEBI, his suggestion of changing wording from negative to positive was not taken in the translation. Korean professors detected the awkwardness problem in Item P19 because of the negative wording, whereas Item P8 was selected as one of appropriately stated items. Item P17 was detected with other type of problems, including vagueness.

The Korean professors discussed the appropriate number of negatively worded items in a scale. They believe that negative items in a row possibly influence that a student perceives a pattern of a negative wording occurring in the following item. Thus, negative items can come alternatively, at most, with positive items in a scale. By the argument, the eight items of negative wording looks too many out of the 13 PMTE items. This discussion sounds logical; however, more research about determining the number of negative items in a scale is needed.

Needs for the Instrument for Secondary Preservice Teachers

Measuring mathematics teaching efficacy beliefs for preservice teachers can help to evaluate the mathematics teacher education program. Even though the MTEBI was developed for elementary preservice teachers, it might be used for secondary preservice teachers, too. However, there exists a fundamental difference between the elementary teacher (covering 1-6 Grades) education program and the secondary teacher (covering 7-12 Grades) education program in Korea. Elementary teachers are all-subjects (including arts, music, and physical exercises) generalists while secondary teachers are one-subject specialists. The reviewers found that some items, for example P3, in the MTEBI were not appropriate for secondary preservice teachers; they suggested using a separated instrument for secondary preservice teachers.

The first example of modifying the MTEBI for secondary preservice teacher is Item P3. The item in the original MTEBI was stated as: "Even if I try very hard, I will not teach mathematics as well as I will most subjects." Since secondary preservice teachers will teach only one subject mathematics, the clause, 'as well as I will most subjects,' was not appropriate for them. It can be changed to, 'as well as other mathematics teachers will.' The next example is 'teaching elementary mathematics' in Item P11, where the word 'elementary' needs to be removed for the secondary preservice teachers. In Item O14, 'child's teacher' is a classroom teacher in the elementary school, but it can be either a homeroom teacher or a mathematics teacher in the secondary (middle and high) school. For secondary preservice teachers, 'child's teacher' needs to be changed to 'students' mathematics teacher.' In addition, some words in the MTEBI were changed when developing a new instrument for secondary preservice teachers: from 'teachers' to 'mathematics teachers' from 'teaching' to 'mathematics teaching', and from 'children' to 'students'.

CONCLUSION

This study revealed that the Korean professors' unique perspectives on mathematics teaching efficacy assisted in clarifying the translation of the MTEBI for their homeland preservice teachers. Many items were found to have problems and the reviewers provided suggestions on how these items can be modified. Throughout the results from the interviews and discussion, several recommendations for revising the MTEBI emerged:

- Use the wording 'I will be able/unable to' prior to the verb in the PMTE items.
- Use the appropriate if-then structure in MTOE items.
- Avoid using frequency and/or degree adverbs: generally, typically, usually, very, often, most likely.
- Change awkward negative wordings to positive wordings.
- Use a new instrument for secondary preservice teachers.

According to those recommendations, the whole MTEBI including both appropriate and inappropriate items was revised (see Appendix C). In the revised version, we suggest separate the items by the two groups each of which the PMTE and the MTOE items are listed, respectively. Also, Items P8 and P11 are changed in order so no two negative items are located in a row. This revised instrument was used as a basis for developing a version of MTEBI for secondary preservice teachers (see Appendix D).

Even though the revised instruments were considered to provide more accurate information about Korean preservice teachers' efficacy beliefs in mathematics teaching, a future study should test the reliability and validity of the instrument. In particular, the instrument for secondary preservice teachers is a new instrument and should be tested before use in a research study. And lastly, for other cross-cultural researchers who want to translate the MTEBI (or other instruments) into their languages, they can apply a framework similar to the one used in this study.

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APPENDIX A
THE MTEBI REVIEW PROTOCOL (TRANSLATED FROM KOREAN)

Personal Information:

Name:

Title:

Career (Year):

Mathematics Specialty:

Algebra Analysis Geometry Topology Statistics Mathematics Education

Other:

How much are you interested in mathematics teacher education?

A little

Some

Much

Very much

MTEBI Information:

The Mathematics Teaching Efficacy Beliefs (MTEBI) measures the feeling of what degree preservice teachers teach efficaciously. The MTEBI has two subscales,

- (a) Personal Mathematics Teaching Efficacy (PMTE), and
- (b) Mathematics Teaching Outcome Expectancy (MTOE).

The PMTE defines the beliefs of a teacher's ability to teach mathematics effectively while the MTOE defines the beliefs that effective mathematics teaching brings a positive outcome in students' mathematics learning. The PMTE items are all 13 items (2, 3, 5, 6, 8, 11, 15, 16, 17, 18, 19, 20, 21) and the MTOE items are all 8 items (1, 4, 7, 9, 10, 12, 13, 14). A PMTE item is stated in the first person and in the future tense while an MTOE item is stated in the third person and in the present tense. Some PMTE items are negatively worded.

Review Directions:

The purpose of this review is to obtain your opinion on each MTEBI item's wording regarding the reality of mathematics education in Korea including socio-cultural milieu. Use the following five questions to review the 21 items of the MTEBI.

1. Which of the PMTE items do you think are appropriately state the personal mathematics teaching efficacy for your students? Then, why?
2. Which of the PMTE items do you think are inappropriately state the personal

mathematics teaching efficacy for your students? Then, why not?

3. Which of the MTOE items do you think are appropriately state the personal mathematics teaching efficacy for your students? Then, why?
4. Which of the MTOE items do you think are inappropriately state the personal mathematics teaching efficacy for your students? Then, why not?
5. Add a new item you think help to make the MTEBI better.

Thank you for your time.

APPENDIX B
AN EXCERPT OF PEER REVIEWED RESPONSES
(Translated from Korean)

O1. When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.

(Professor J)

The main clause can include two cases: (1) A reason why a student does better than usual is the teacher's a little extra effort; and (2) When a teacher exerted a little extra effort, it often results in better outcome. The case (1) shows a belief that a teacher is one of the factors positively influencing to student learning, and the case (2) is interpreted as asking how frequently the better outcome of such influence is observed. In my opinion, an item ought to ask one thing only.

(Professor P)

This item was viewed as the converse of the statement: A teacher's effort influences student outcome. It is far way from logic.

P18. Given a choice, I will not invite the principal to evaluate my mathematics teaching.

(Professor J)

Words and the statement are very awkward—See Alternative 1. It does not seem to ask mathematics teaching efficacy. Interpretation literally as it were, it looks like asking about preference to the principal. Rather, for mathematics teaching efficacy, does it appropriate if the item focuses on the willingness of class observation?—See Alternative 2.

Alternative 1: If I can choose persons to observe my class, then I will not choose the principal.

Alternative 2: If needed, I will agree to open my class to others (such as peer teachers, staff, principal, etc.)

(Professor P)

You may state the above alternatives more neatly. For example, I have no fear to open my class to others; I will teach mathematics well in a class open to others; and I certainly will have a high rating at the class evaluation.

APPENDIX C

THE REVISED MTEBI ITEMS FOR ELEMENTARY PRESERVICE TEACHERS (TRANSLATED FROM KOREAN)

PMTE

- P2 I will be able to find continually better ways to teach mathematics.
- P3 I will be unable to teach mathematics as well as I will other subjects, even if I try very hard.
- P5 I will be able to know how to teach mathematics effectively.
- P6 I will be unable to be effective in observing students' mathematics activities during a lesson.
- P8 I will be unable to teach mathematics effectively.
- P11 I will be able to understand mathematics concepts well enough to be effective in teaching elementary mathematics.
- P15 I will able to use manipulatives to explain to students why mathematics works.
- P16 I will be able to answer a student's mathematics question.
- P17 I will be unable to have the necessary skills to teach mathematics.
- P18 I will agree to open my class to others to evaluate my mathematics teaching.
- P19 I will be unable to help a student understand mathematics concepts.
- P20 I will be able to use students' questions when teaching mathematics.
- P21 I will be unable to know what to do to turn students on to mathematics in the future.

MTOE

- O1 If a teacher exerted extra effort to a student, then the student does better than usual in mathematics.
 - O4 If a teacher has found a more effective teaching approach, then the student has improved grades in mathematics.
 - O7 If a teacher's mathematics teaching is effective, then the students' mathematics achievement increases.
 - O9 If a teacher gives effective mathematics teaching, then inadequacy of a students' mathematical performance can be overcome.
 - O10 If a teacher gives extra attention to a low-achieving student, then the student shows progress in mathematics learning.
 - O12 If a teacher has more strong responsibility, then the students' mathematics achievement is getting better.
 - O13 If a teacher teaches mathematics effectively, then students' achievement in mathematics is improved.
 - O14 If a teacher performs effectively in a mathematics lesson, then the student shows more interest in mathematics.
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APPENDIX D

THE REVISED MTEBI ITEMS FOR SECONDARY PRESERVICE TEACHERS
(TRANSLATED FROM KOREAN)

 PMTE

- P2 I will be able to find continually better ways to teach mathematics.
 P3 I will be unable to teach mathematics as well as others will, even if I try very hard.
 P5 I will be able to know how to teach mathematics effectively.
 P6 I will be unable to be effective in observing students' mathematics activities during a lesson.
 P8 I will be unable to teach mathematics effectively.
 P11 I will be able to understand mathematics concepts well enough to be effective in teaching mathematics.
 P15 I will be able to use manipulatives to explain to students why mathematics works.
 P16 I will be able to answer a student's mathematics question.
 P17 I will be unable to have the necessary skills to teach mathematics.
 P18 I will agree to open my class to others to evaluate my mathematics teaching.
 P19 I will be unable to help a student understand mathematics concepts.
 P20 I will be able to use students' questions when teaching mathematics.
 P21 I will be unable to know what to do to turn students on to mathematics in the future.

 MTOE

- O1 If a mathematics teacher exerted extra effort to a student, then the student does better than usual in mathematics.
 O4 If a mathematics teacher has found a more effective teaching approach, then the student has improved grades in mathematics.
 O7 If a mathematics teacher's teaching is effective, then the students' mathematics achievement increases.
 O9 If a mathematics teacher gives effective teaching, then inadequacy of a students' mathematical performance can be overcome.
 O10 If a mathematics teacher gives extra attention to a low-achieving student, then the student shows progress in mathematics learning.
 O12 If a mathematics teacher has more strong responsibility, then the students' mathematics achievement is getting better.
 O13 If a mathematics teacher teaches mathematics effectively, then students' achievement in mathematics is improved.
 O14 If a mathematics teacher performs effectively in a mathematics lesson, then the student shows more interest in mathematics.
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