

**THE RELATIONSHIP BETWEEN
MATHEMATICS SELF-EFFICACY AND
MATHEMATICS ACHIEVEMENT OF
MATHAYOMSUKSA STUDENTS IN THE
ENGLISH PROGRAM OF ST. JOSEPH
BANGNA SCHOOL**

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Abstract: The purpose of this study was to determine the levels of mathematics self-efficacy and mathematics achievement of mathayomsuksa students in the English program of St. Joseph Bangna School and the relationship between the two. The study focused on 198 mathayomsuksa 1 to 3 students of the English program enrolled in the academic year 2012-2013. The students sample answered mathematics self-efficacy questionnaires to rate their confidence in being able to solve math problems that they had already learned. The students' test scores in mathematics in the final examination were the basis of mathematics achievement in this study. The researcher had the hypothesis that there exists a significant relationship between mathematics self-efficacy and mathematics achievement of mathayomsuksa students in the English program. Frequency, mean, standard deviation and Pearson Product Moment Correlation were used to analyze the data. The study's findings were: 1) The levels of mathematics achievement of mathayomsuksa students based on the mathematics final test results were relatively high (excellent); 2) The levels of mathematics self-efficacy of mathayomsuksa students were high (complete confidence); and 3) There was a significant and positive relationship between mathematics self-efficacy and mathematics achievement of mathayomsuksa students, meaning students with higher self-efficacy had higher scores in mathematics achievement test. These results are consistent with previous researches showing a significant relationship between students' self-efficacy and achievement.

Keywords: Mathematics, Self-efficacy, Achievement, Mathayomsuksa students, English Program

Introduction

Students' ability to learn mathematics has been the concern of researchers for many years. Research field concerning student success in mathematics has been

dominated by previous mathematics achievement. There has been also a great deal of discussions about students and their self-efficacy concerning mathematics.

Self-efficacy is an important concept in social cognitive theory, which has been widely recognized as one of the most prominent theories about human learning (Ormrod, 2008). First developed by Albert Bandura (1977; 1986), self-efficacy refers to learners' beliefs about their ability to accomplish certain tasks. Many researchers, including Bandura, have demonstrated that self-efficacy affects human motivation, persistence, efforts, action, behavior, and achievement (Bandura, 1977; Zimmerman, 2000).

Although numerous studies have been conducted on the relationship between attitude toward mathematics and mathematics achievement, comparatively there was a deficiency of research in examining the relationship between mathematics self-efficacy and mathematics achievement. (Liu & Koirala, 2009). Also, self-efficacy particularly regarding mathematics has been found to be related to mathematics achievement in western settings (Hackett & Betz, 1983; Pajares & Graham 1999; Pajares & Schunk 2001; Zimmerman, 2000), however, very less is known how self-efficacy operates in non-western population, particularly in Asian samples.

Pajares and Miller (1994) noted that the years in middle school (mathayomsuksa 1 to 3) are particularly significant for girls because during this time self-perceptions of ability emerge and girls in middle school are thought to show less interest in math and report higher levels of anxiety.

However, there were some studies that showed that girls from single-gender schools performed better than girls from co-educational schools. According to Tully and Jacobs (2008), women from single-gender secondary schools displayed the high self-perception of mathematics ability. But they also found out in their same research study that many students failed mathematics due to low self-efficacy.

Mathematics is also a big concern of Thai educators considering that based on Organization for Economic Co-operation and Development - Programme for International Student Assessment (OECD – PISA) 2009 results, Thailand ranked 48th among the 65 countries assessed in the domain of mathematics. The mean score of 419 of Thailand was statistically significant below the OECD average (OECD, 2010).

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Also, as the researcher is being the head of the Mathematics Department in the English Program of St. Joseph Bangna School, he found out that mathayomsuksa 1 to 3 students in the English program of St. Joseph Bangna School were having difficulties in mathematics in previous semesters.

Due to the above reasons, the researcher was inspired to conduct a study to determine the levels of math self-efficacy and mathematics achievement of the mathayomsuksa 1 to 3 students in the English program, and the relationship between the mathematics self-efficacy and mathematics achievement in a single-gender schools, particularly all-girl schools, to see if single-gender environments foster math efficacy levels among female students and if these environments affect attitudes about math.

Objectives

With regard to the purposes of this study, the researcher considered the following objectives.

1. To determine the levels of mathematics achievement of mathayomsuksa students in the English program.
2. To determine the levels of mathematics self-efficacy of mathayomsuksa students in the English program.
3. To determine the relationship between mathematics self-efficacy and mathematics achievement of mathayomsuksa students in the English program.

Literature Review

This presents a review of the theory and research literature which served as the theoretical foundation of this study which aimed to investigate the relationship between self-efficacy and mathematics achievement of mathayomsuksa 1 to 3 students of St. Joseph Bangna School.

St. Joseph Bangna School

St. Joseph Bangna School is one of the private schools in Thailand owned and run by the sisters of St. Paul de Chartres. It is an all-girl school that exists for the main purpose of serving the nation by providing scientific and humanistic knowledge to prepare the students for the future as professionally skilled individuals and responsible citizens of the world.

The school offers two programs, the English program and the Thai program, from prathomsuksa 1 (grade 1) to mathayomsuksa 6 (grade 12). The average number of students per class in the Thai program is 40 and the average number of students per class in the English program is 24.

Self-efficacy

Self-efficacy is an important concept in social cognitive theory, which has been widely recognized as

one of the most prominent theories about human learning according to Omrod (2008). Self-efficacy refers to the person's beliefs in his capabilities to organize and execute the required courses of action to handle prospective situations (Bandura, 1997). Bandura asserted that these person's beliefs influence action, effort, perseverance, resilience to adversity, and realization of goals. Therefore, the person's beliefs associated with individual capability often determine outcomes before any action occurs.

In an academic context, self-efficacy reflects how confident students are in performing specific tasks. However, high self-efficacy in one area may not coincide with high self-efficacy in another area. Self-efficacy is specific to the task being undertaken. For example, high self-efficacy in mathematics does not necessarily accompany high self-efficacy in English subject. Having high self-efficacy does not also necessary mean that students believe they will be successful. While self-efficacy indicates how students strongly believe they have the skills to do well, they may also believe other factors will keep them from succeeding (Siegle, 2000).

According to Bandura (1997), individual's beliefs about his efficacy can be developed by four main sources of influence. These are mastery experiences (performance accomplishments), vicarious experiences, social persuasions and physiological factors.

Mastery Experiences - Both positive and negative experiences can influence the ability of a person to perform a given task. If one has performed well at a given task previously, he is more likely to feel competent and perform well at a similarly associated task (Bandura, 1977). For example, if a student did well in a previous math test, he is more likely to feel confident and have high self-efficacy in the next math test. But the opposite is also true. If a student experiences a failure, his self-efficacy is likely to be reduced. However, if this failure is later overcome, it can serve to increase self-motivated persistence when the situation is considered as an achievable challenge (Bandura, 1977).

Vicarious Experiences - Bandura (1997) has claimed that social comparisons are fundamental features of vicarious experience and greatly affect the choice and proficiency of models. From these models, strategies are learned that help increase efficacy. A person can watch another perform and then compare their competence with the other's competence. If a person sees someone similar to them succeed, it can increase their self-efficacy. However, the opposite is also true; seeing someone similar fail can lower self-efficacy (Bandura, 1997).

Social Persuasions - According to Redmond (2010), self-efficacy is also influenced by

encouragement and discouragement from other persons. Using verbal persuasion in a positive way, such as “You can do it!” leads individuals to exert more effort for a greater chance of success. However, if the verbal persuasion is negative, such remark as “This is unacceptable! You’re not good!” can lead to doubts about one self-resulting in lower chances of success.

Physiological Factors - Bandura (1977) also stated that individuals also experience physiological feelings and how they perceive these emotional arousals influences their beliefs of efficacy. Some individuals may experience anxiety and agitation when they make a presentation or taking test, thus making them uncomfortable and have lower beliefs of self-efficacy. Thus, it is important to note that if one is more at ease with the task at hand they will feel more capable and have higher beliefs of self-efficacy.

Although all four sources of self-efficacy information play important roles in the creation of efficacy beliefs, it is the interpretation of this information that is critical. Cognitive processing determines how these sources of self-efficacy will be weighed and how they will influence the analysis of the task and the assessment of personal competence (Bandura, 1997).

Schunk (1996) stated that the choices we make, the effort we put forth, and how long we persist are influenced by self-efficacy. Self-efficacy beliefs also determine how people feel, think, motivate themselves and behave. These beliefs produce diverse effects through four major psychological processes. These are cognitive process, motivational process, affective process and selection process.

Cognitive Process - Most courses of action are

a high sense of efficacy, visualize success scenarios that provide positive guides for performance. Those who doubt their efficacy visualize failure scenarios and dwell on the many things that can go wrong.

Motivational Process - According to Bandura (1994), self-efficacy beliefs play an important part in the self-regulation of motivation. Most human motivation is cognitively generated. People motivate themselves and form beliefs about what they can do. They set goals for themselves and plan courses of action designed to realize valued futures.

Affective Process - Perceived coping self-efficacy regulates avoidance behavior as well as anxiety arousal. The stronger the sense of self-efficacy, the bolder people are in taking on taxing and threatening activities (Bandura, 1994).

Selection Process - Bandura (1994) also stated that self-efficacy beliefs can shape the course of life paths of individuals through choice-related processes. People avoid activities and situations they believe beyond their personal capabilities, but they readily undertake challenging activities and select situations they see themselves capable of handling.

Theories that Incorporate Self-Efficacy

Social Cognitive Theory

The social cognitive theory of Bandura explains how people acquire and maintain certain behavioral patterns while also providing the basis for intervention strategies. The theory considers that human functioning is molded by the reciprocal interaction of behavior; personal factors, including cognition; and environmental events. This model is popularly known as the Triadic Reciprocal Determinism (Figure 1).

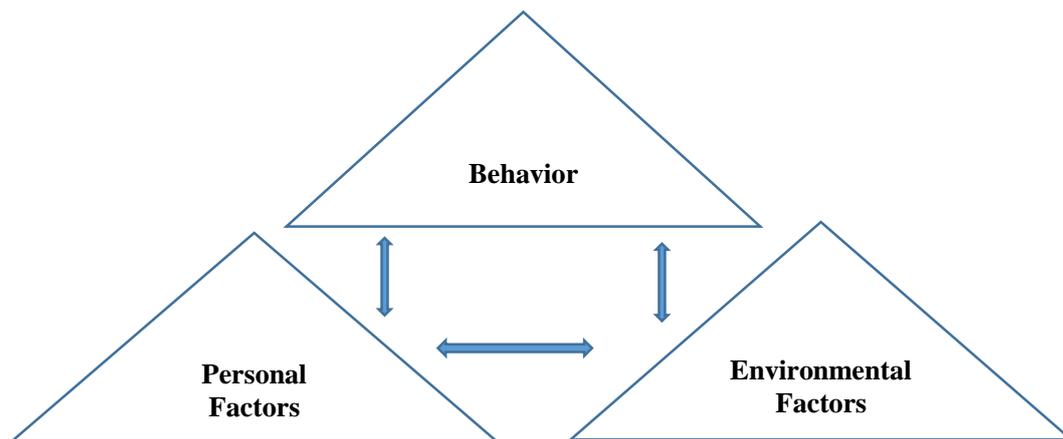


Figure 1: Triadic Reciprocal Determinism

Source: *Self-Efficacy* (Bandura, 1994).

initially organized in thought. Individuals’ beliefs in their efficacy influence the types of anticipatory scenarios they construct and rehearse. Those who have

Bandura, however, does not suggest that the three factors in the Triadic Reciprocal Determinism model make equal contributions to behavior. The relative

influence of behavior, environment, and person depends on which factor is strongest at any particular moment (Redmond & Moser, 2011).

The social cognitive theory is composed of four processes of goal realization which are interrelated and each has an effect on motivation and goal attainment (Redmond & Moser, 2011). These are self-observation, self-evaluation, self-reaction and self-efficacy.

Self-observation can be used to assess individual's progress toward attainment of goal as well as motivate behavioral changes. Regularity and proximity are the two important factors with regards to self-observation. Regularity means that the behavior should be continually observed and proximity means that the behavior should be observed while it occurs, or shortly after. However, self-observation alone is not sufficient because motivation depends on one's expectations of outcomes and efficacy (Redmond & Moser, 2011).

Self-evaluation compares an individual's current performance with a desired performance or specific goal. Redmond & Moser (2011) stated that specific goals specify the amount of effort required for success and boost self-efficacy because progress or accomplishment can be easily measured. They also suggested that a person with little regard for his goal will not evaluate performance.

Self-reaction to individual's own performance can also be motivating. If progress is considered acceptable, then one will have a feeling of self-efficacy to continue the task and will be motivated towards the achievement of their goal. A negative self-evaluation may also be motivating in a way that one may strive harder provided that they consider the goal as valuable. Bandura (1989) stated that self-reaction also allows a person to re-evaluate their goals in conjunction with their attainments.

Self-efficacy beliefs influence the choices people make and the courses of action they pursue. People tend to engage in tasks about which they feel competent and confident and avoid those in which they do not. Efficacy beliefs also influence the amount of stress and anxiety individuals experience as they engage in an activity (Pajares & Miller, 1994).

Expectancy Theory (VIE Theory)

This theory by Victor Broom, also known as the VIE (expectancy, instrumentality, and valence) theory, is based on the beliefs that an individual's effort will lead to performance, which in turn, will lead to a specific outcome. In this theory, motivation is regulated by the expectation that a given course of behavior will produce certain outcomes and the value of those outcomes. Individuals act on their beliefs about what they can do, as well as on their beliefs about the likely outcomes of performance. The motivating influence of

outcome expectancies is thus partly governed by self-beliefs of efficacy. According to Bandura (1997), individuals take action when they hold efficacy beliefs and outcome expectations that make the effort seem worthwhile.

People with high self-efficacy are more likely to respond with renewed effort (expectancy) when feedback shows that they are not reaching their goals by developing more successful strategies (Redmond & Moser, 2011). However, individuals with low self-efficacy, given the same circumstances, may perform poorly because their low self-efficacy impairs their motivation and effort.

Attribution Theory

Attribution theory of Bernard Weiner is said to be the most influential contemporary theory with implications for academic motivation. It incorporates behavior modification in the sense that it emphasizes the idea that learners are strongly motivated by the pleasant outcome of being able to feel good about themselves. It incorporates cognitive theory and self-efficacy theory in the sense that it emphasizes that learners' current self-perceptions will strongly influence the ways in which they will interpret the success or failure of their current efforts and hence their future tendency to perform these same behaviors (Learning Theories Knowledgebase, 2011).

Causal attributions affect motivation, performance and affective reactions mainly through beliefs of self-efficacy (Bandura, 1994). Individuals who perceived themselves as highly efficacious attribute their failures to insufficient effort, those who perceived themselves as inefficacious attribute their failures to low ability.

Self-Efficacy in Single-Gender Schools

Some researchers and educational practitioners have suggested several reasons that single-gender schools may provide better environments for female students with regard to both teacher-student and peer-group interactions, which may encourage them to pursue their educational careers in STEM (Science, Technology, Engineering and Math) as well as improve female students' overall educational outcomes (Whitlock, 2006).

Single-gender school classrooms were rated higher in student involvement in the class, higher in affiliation among students than coed school classrooms, and higher in order and organization and teacher control. Students from single-gender schools are more academically oriented whereas students from coed schools are more socially oriented. Also, achievement levels in single-gender schools typically show that academic achievement is substantially higher than in coed schools (Whitlock, 2006).

Park, Berhman & Choi (2011) stated that all-girl high schools enhance female education because of the absence of social interactions with boys that divert attention from academic activities and because of the absence of competition from boys for teachers' attention. Also, female students in single-gender schools spend significantly more time on homework than those from coed schools.

Another positive finding on single-gender schools, especially for girls, is related to classroom dynamics that affect students' self-concept, self-efficacy and confidence in academic learning (UNESCO, 2007). Rodriguez (2003) found in her study, that girls in a single-gender classroom had the sense of ownership of their class, while girls did not feel the sense of ownership in coeducational classrooms because they perceived the dominance of boys. Also, girls in a single-gender classroom reported that they were not afraid of asking and answering questions because they were no longer concerned about reactions from boys as in usual coeducational classrooms. Along with the sense of ownership of class, female students reported improved confidence in their academic abilities as a consequence of attending the single-gender classroom (Rodriguez, 2003).

In 1989, Jimenez and Lockheed assessed the performance of eight graders on standardized math tests from both single-gender and co-educational schools in Thailand to gauge the relative effectiveness of single-gender education versus coeducation on student attitudinal and cognitive outcomes. They found out that girls in girl-only schools scored higher in mathematics as compared to girls from coed school. Based on the same research, the result of the study implied that an average single-gender school eighth-grade Thai girl chosen at random would improve her achievement by attending a single-gender school. These results play a vital role in supporting single-gender education for girls in terms of math achievement (UNESCO, 2007).

Factors Affecting Mathematics Achievement

For the last three decades, mathematics educators and researchers have focused on factors affecting students' mathematics achievement (Savas, et.al. 2010). Different reasons have been given by researchers for the performance of the students in mathematics. Savas, Tas and Duru (2010) found that four factors such as student background, self-regulated cognitions in mathematics, learning strategies and school climate have significant effects on the achievement.

However, Saritas and Akdemir (2009) identified three factors or predictors in math achievement: demographic, instructional and individual factors. Demographic factors that are known to be related to mathematics achievement are gender, socio-economic

status and parents' educational level. Instructional factors are math curriculum, teachers' instructional strategies, and teachers' competency in math education, school context and facilities. Individual factors include self-directed learning, arithmetic ability, motivation or concentration, self-efficacy and attitude towards mathematics.

Mathematics Self-Efficacy and Mathematics Achievement

Many psychologists, over the years, had become aware of the fact that an individual's self-efficacy or his attitude to and perception of himself relates closely to how he learns and behaves. For this same reason that caused Edstrom (1996) to assume that many students have difficulty in school not as a result of low intelligence or physical impairment, but because they have perceived themselves as unable to do academic work.

Students' self-efficacy for mathematics may be defined as their judgments about their potential to learn the subject successfully. Those students with higher levels of self-efficacy generally set higher goals, apply more effort, persevere longer in difficult situations and are more likely to use self-regulated learning strategies (Pajares & Schunk, 2001).

Expectations about doing well in mathematics are closely related to one's beliefs about personal capabilities for successfully performing specific tasks. For this reason, it is said to be important for mathematic educators to know the how their learners feel, think, and act, about, within, and toward mathematics (Tait-McCutcheon, 2008).

Bandura (1977) believed that the development of life-long learners of mathematics depended on the interaction of three linked psychological domains of functioning: the affective, the cognitive, and the conative. One way to gain insight into how their learners feel, think, and act, about and toward mathematics is to examine these three psychological domains of functioning (Pajares & Schunk, 2001).

The affective domain includes learners' beliefs about themselves and their capacity to learn mathematics; their self-esteem and their perceived status as learners; their beliefs about the nature of mathematical understanding; and their potential to succeed in the subject. The cognitive domain includes learners' awareness of their mathematical knowledge: their strengths and weaknesses; and their development of links between aspects of the subject. The conative domain includes learners' intentions and dispositions to learn, and their approach to monitoring their own learning and to self-assessment. It is important to examine each domain as a student may feel efficacious within the affective domain but less confident within the cognitive domain (Pajares & Schunk, 2001).

Many research studies have revealed that there is a positive and significant relationship between students' self-efficacy beliefs and their mathematics achievement. Students with low self-efficacy toward a task are more likely to avoid it, while those with high self-efficacy are not only more likely to attempt the task, but they also will exert more effort and persist longer in the face of difficulties. Self-efficacy beliefs

Conceptual Framework

Mathayomsuksa 1-3 students in the English program of St. Joseph Bangna School were considered in this study. Student participants were given a questionnaire to determine their level of mathematics self-efficacy. Their final examination scores in mathematics in the second semester of the school year 2012-2013 were the basis of mathematics achievement in this study.

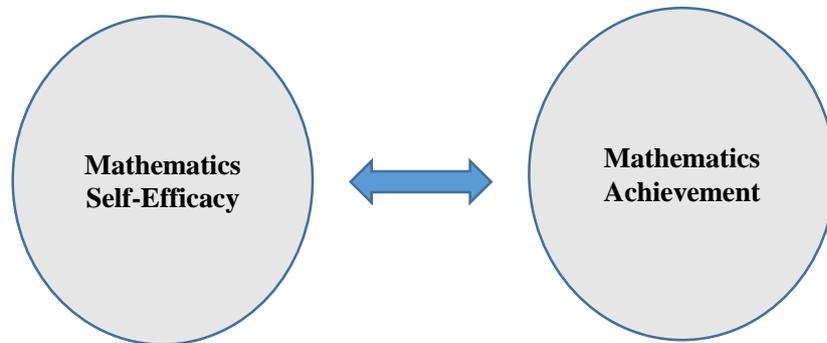


Figure 2: Conceptual Framework of This Study

of the students influence what activities they select, how much effort they exert, how persistent they are in the face of difficulties, and the difficulty of the goals they set. Students with low self-efficacy do not expect to do well, and they often do not achieve at a level that is commensurate with their abilities. They do not believe they have the skills to do well so they don't try (Pajares & Schunk, 2001).

It was further found that mathematics self-efficacy is a good predictor of mathematics performance irrespective of the indicators of performance and regardless of any other variables. Pajares & Miller (1994) stated in their report that mathematics self-efficacy is a better predictor of mathematics performance than mathematics anxiety, previous involvement in mathematics, mathematics self-concept and prior mathematics performance. They even noted that self-efficacy beliefs were even found to be a stronger predictor of performance than general mental ability. Research findings also support the observation that students with high mathematics achievement have higher and more accurate efficacy beliefs (Pajares & Miller, 1994).

Pajares and Schunk (2001) asserted that the connection between self-efficacy and achievement gets stronger as students advance through school. By the time students are in college, their self-efficacy beliefs are more strongly related to their achievement than any measure of their ability. For the teachers to develop high educational achievement among their students, it is essential that they begin building stronger self-efficacy as early as possible.

Method/Procedure

The research was a quantitative statistics that include both descriptive and correlation studies. Descriptive study was used in determining the levels of mathematics self-efficacy and mathematics achievement, while correlation study was used in determining the relationship between the mathematics achievement and mathematics self-efficacy.

All one hundred and ninety-eight (198) students in mathayomsuksa 1 to 3 in the English program of St. Joseph Bangna School in the second semester of the school year 2012-2013 were used as the subjects of this study, in other words, the population and sample were the same.

The sample students responded to the Mathematics Self-efficacy Questionnaire which was patterned after the Mathematics Self-efficacy Scale which was used by Ana Rodriguez (2003) to middle school students. This was a 20-item questionnaire wherein the students were asked to rate their confidence in being able to solve math problems that they have already learned, such as decimals, square roots, algebraic equations, angles, percentage and fractions. A ten-point Likert type scale was used with zero being no confidence at all to nine being complete confidence.

The reliability of the instrument was calculated by using Cronbach's Alpha. The data gathered from the 198 students were used in determining the reliability of the 20-item instrument which resulted to Cronbach's Alpha value of 0.863.

In determining the level of mathematics self-efficacy (MSE) of the mathayomsuksa students, the

following standards were used: MSE Scores of 0 to 60 (Little or No Confidence) - low level of MSE; 61 to 120 (Some Confidence) - moderate; and 121 to 180 (Complete Confidence) – high level of MSE.

The test scores (X) in mathematics of the sample students in the final examination in the second semester of the school year 2012-2013 were the basis of the mathematics achievement in this study. In determining the level of mathematics achievement (LMA) of the mathayomsuksa students, the following standards were used: test scores of $X \leq 7.5$ – very low; $7.5 < X \leq 15$ – low; $15 < X \leq 22.5$ - moderate, and $22.5 < X \leq 30$ – high.

Frequency, mean and standard deviation were used to determine the levels of mathematics achievement and mathematics self-efficacy of the students. Pearson Product Moment Correlation was used to determine the relationship between the mathematics self-efficacy and mathematics achievement.

Findings/Results

From the analysis of data, the findings were as follows:

1. The levels of mathematics achievement of mathayomsuksa students based on the mathematics final test results were relatively high (excellent) as Table 1 shows a mean score of the total sample population of 22.91 out of the maximum possible score of 30.

Table 1: Mean and Standard Deviation of Mathematics Achievement of Mathayomsuksa Students

Grade Level	Number of Students	Mean of the Scores	Standard Deviation
Mathayom suksa 1	77	22.78	4.675
Mathayom suksa 2	57	24.56	3.469
Mathayom suksa 3	64	21.44	6.042
Total Population	198	22.91	5.003

The highest mean was in mathayomsuksa 2 students with a score of 24.56, followed by mathayomsuksa 1 with 22.78 and mathayomsuksa 3 with 21.59. About 65% of the students got a score higher than the mean score.

2. The levels of mathematics self-efficacy of mathayomsuksa students were high (complete confidence) as Table 2 shows a mean score of 121.96 out of the maximum possible score of 180.

Table 2: Mean and Standard Deviation of Mathematics Self-efficacy Scores of Mathayomsuksa Students

Grade Level	Number of Students	Mean of the Scores	Standard Deviation
Mathayom suksa 1	77	123.61	29.516
Mathayom suksa 2	57	112.54	30.375
Mathayom suksa 3	64	128.36	28.127
Total Population	198	121.96	29.856

The highest mean was in mathayomsuksa 3 students with a score of 128.3 followed by mathayomsuksa 1 with 123.61 and mathayomsuksa 2 with 112.54. More than 50% of the students showed a self-efficacy score higher than the mean score.

3. There was a positive and significant relationship between mathematics self-efficacy and mathematics achievement of mathayomsuksa students, as Table 3 shows. Increases in mathematics self-efficacy were correlated with increases in mathematics, meaning students with higher self-efficacy had higher scores in mathematics achievement test.

Table 3: Relationship between Mathematics Self-efficacy and Mathematics Achievement

Grade Level	Pearson Product Moment Coefficient (r)	Level of Significance (p)	N
Mathayomsuksa 1	.533**	.000	77
Mathayomsuksa 2	.307*	.020	57
Mathayomsuksa 3	.585**	.000	64
Total Population	.423**	.000	198

Note: *. Correlation is significant at the 0.05 level (2-tailed). **.Correlation is significant at the 0.01 level (2-tailed).

Discussion

Levels of Mathematics Achievement and Mathematics Self-efficacy

For the levels of mathematics achievement, frequency and mean indicated that the sampled students had a relatively high mathematics achievement, in general, based on their math test results in the final examination. However, it is important to note that mathematics

achievement in this study was only based on one particular test, which was the final examination in mathematics in the second semester of the school year 2012-2013. Based on the test performances of the students in the last three semesters, the result of this examination has proven that students were doing better in the final examinations than in the midterm examinations. The students seemed to study harder for final examinations than for midterm examinations.

It is also important to note that the mathematics achievement of the sampled students can be attributed to different factors mentioned in the literature, such as demographic, instructional and individual (Saritas & Akdemir, 2009).

For mathematics self-efficacy, frequency and mean also indicated a relatively high level for the sampled students. Generally, the sample students had shown high confidence in solving specific math problems appropriate to their levels. However, it is fairly to note Bandura's (1986) notion that young students are generally overconfident about their abilities. He says that some overestimation of capability is useful, since it increases effort and persistence. He also further contends that accurate evaluation of capability while it enables the student to assess their problem-solving strategies more accurately, it does, however, limit students' sense of optimism. Also, attention is needed for the protection of the overconfident students from danger of disappointment especially in cases of continual failures. Experts say that students' self-efficacy beliefs become more stable and accurate over time, and it is very difficult to change (Bandura, 1997).

Nevertheless, the high level of self-efficacy result in this study is in agreement with UNESCO's (2007) positive findings on single gender schools, especially for girls, which is related to classroom dynamics that affect students' self-efficacy in academic learning.

Also, the finding of this study supports Rodriguez's (2003) report that female students had shown improved confidence in their academic abilities as a consequence of attending the single-gender classroom.

The Relationship between Mathematics Self-efficacy and Mathematics Achievement

Results of the correlation analysis showed that there was a positive and significant relationship between mathematics self-efficacy and mathematics achievement. This finding supported the research hypothesis that mathematics self-efficacy and mathematics achievement were significantly related. Students with high mathematics self-efficacy were associated with high mathematics achievement. This finding is in agreement with the work of researchers who reported significant relationships between self-

efficacy and academic performances (Bandura, 1996; Fast, et.al., 2010; Hackett & Betz, 1983; Liu & Koirala, 2009; Pajares & Miller, 1994; Pajares & Graham, 1999; Pajares & Schunk, 2001; Zimmerman, 2000).

This finding is also generally consistent with the basic assumption of Bandura's self-efficacy. Self-efficacy has been shown to influence students' mathematical achievement (Bandura, 1996; Pajares & Graham, 1999). Bandura (1997) even contends that self-efficacy can influence many parts of one's life such as motivation and perseverance in times of difficulties and failures, resilience to adversity and quality of analytical thinking.

Mathematics is not an easy subject, thus difficulties and setbacks occur often, making it important to have the motivation, perseverance, and resilience to continue to put forth effort in a mathematics classroom. Mathematics does not always come naturally to students, but they can succeed if they keep working hard and do not give up. Zimmerman (2000) found "evidence that self-efficacious students participate more readily, work harder, persist longer, and have fewer adverse emotional reactions when they encounter difficulties than do those who doubt their capabilities" (p. 86). Moreover, within the domain of mathematics, fast, et.al (2010) found that students with less self-efficacy will give up easier on difficult math problems and are less accurate in math computation.

It is also important to acknowledge limitations of this study. Previous researchers had typically observed a stronger relationship between math self-efficacy and math achievement than that observed in this study (e.g. Pajares & Graham, 1999). Pajares and Miller (1994) suggest that the magnitude of association between self-efficacy and achievement depends mainly on the match between the self-efficacy index and the criterion performance task. For example, asking students to rate their confidence in their ability to solve a specific math problem (e.g. 25% of 120) should correlate highly with their success in solving that exact or much similar math problem, whereas asking students to rate their overall confidence in their ability to do math should be relatively less related to their performance on a multidimensional math test (Fast, et.al., 2010). In this research study, sampled students rated their self-efficacy to do well in solving specific problems which were not similar to the math questions in their final test. But the questions in the questionnaire were all about math concepts appropriate to their levels and, then, these ratings were correlated with their performances in their final math tests. Nevertheless, it seems that the distal match between this study's self-efficacy and performance indices had positively proved a significant relationship between math self-efficacy and math performance.

The positive finding in this study also supports the

previous researches that asserted that self-efficacy had been shown to be an accurate predictor of success in academic performance, (Fast, et.al., 2010; Hackett & Betz, 1983). As Pajares and Miller (1994) stated in their report, mathematics self-efficacy is a better predictor of mathematics performance than mathematics anxiety, previous involvement in mathematics and mathematics self-concepts. Also, Liu and Koirala (2009) reported that mathematics self-efficacy was a significantly positive predictor of mathematics achievement. Their findings suggest that students who were confident of their performance in mathematics tended to have better mathematics achievement. Students who have high mathematics self-efficacy could understand well the most difficult material presented. They could do well on math assignments and tests, and, more importantly, they could master the skills being taught in their math classes, hence, they were more likely to have better mathematics achievement. Therefore, there is a need to improve students' self-efficacy which may improve students' mathematics achievement.

Recommendations

Recommendations for Practice

The clear implication of the findings of this research is that since mathematics self-efficacy was significantly and positively associated with students' mathematics achievement, teachers, educational policy-makers and practitioners as well as parents are encouraged to make endeavors to promote and develop self-efficacy of students to enhance their mathematics achievement.

Self-efficacy beliefs are developed through the interpretation of performance outcomes. These beliefs, as discussed in the literature, are based on four primary sources of influence: mastery experience, vicarious experience, social persuasion, and physiological factors (Bandura, 1997). Thus, it is highly recommended to educational practitioners, policy makers and parents to provide the students opportunities to develop self-efficacy through these four sources of influence.

Mastery experiences usually dictate student opinions concerning their perception of their ability in mathematics. Research also showed that mastery experiences are significant predictors of self-efficacy (Bandura, 1997).

For above reasons, it is recommended to educational practitioners to integrate "mastery experience" opportunities into mathematics classes. Hands-on activities and projects that require self-regulation must be included in the course curriculum. Lessons and activities which are tailored-fit to students' ability-level must be also provided. Support to students throughout their struggles must be also given.

Vicarious experiences which may have great influence on student's performance, occurs when these students believe in their ability to achieve certain results after observing other people, like their teachers or peers, who have engaged in the same activity and have acquired success (Bandura, 1986, 1997). For this reason, it is recommended to educational practitioners to create vicarious learning experiences that incorporate opportunities for students to observe the practices and performances of their peers and math professionals in classes and in other activities. This can be done by providing group-works; inviting more advanced students (undergraduate or graduate) or professionals of Science, Technology, Engineering and Mathematics (STEM) into classrooms or seminars to share their experiences and success; and providing influential role models wherein students perceive similarities between the models and themselves.

Social persuasion is particularly instrumental in the development and maintenance of students' self-efficacy (Pajares & Miller, 1994). Positive feedback and encouragement, especially from influential people (e.g., parents and teachers) enhances self-efficacy of the students. To increase mathematics self-efficacy, educational practitioners are recommended to: provide positive, genuine, appropriate, and realistic feedback and support to students; encourage students to persist and study harder despite difficulties and failures; praise students' effort and persistence rather than their ability; enlighten parents and guardians of the importance of supporting their students' interest in school subjects and activities, especially related to mathematics; and encourage the students to participate in extra-curricular mathematics activities.

Physiological factors refer to the individual's emotional and physical states during task preparation and performance. Most prevalent but controllable physiological factors are anxiety and apprehensions. Feeling calm and composed, rather than nervous and worried, when preparing for and performing a task leads to higher self-efficacy (Liu & Koirala, 2009). To reduce anxiety and apprehension related to mathematics, practitioners are recommended to: create a classroom environment where students gain confidence in their math abilities, lower their math anxiety, and participate in a healthy learning community; discuss with the students the experience of math related anxiety and tell them that they can possibly control their physiological reactions; and encourage students to concentrate fully to the task at hand, which should reduce their attention to apprehensions and fears thereby reducing task-related anxiety.

Recommendations for Future Research

Recommendations for future research regarding

mathematics self-efficacy and mathematics achievement are:

- a. Future research may include investigation of the sources of mathematics self- efficacy of the students. It will be interesting to find out the most influential source among the four sources of influence (mastery experience, vicarious experience, social persuasion and physiological factors).
- b. This study only had subjects of high socio-economic status due to the nature of private schools. It would be good to do a research across all socio-economic status levels in Thailand or in any other countries, and find out what the results would look like.
- c. Other future researches of this kind are recommended to follow Pajares and Miller's (1994) suggestion on matching self-efficacy index and the criterion performance task.
- d. This study only had subjects of one program of a single-gender school. A suggestion for a future study would be to compare mathematics self-efficacy and mathematics achievement of students from single-gender school and co-educational schools.

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