Journal of Research, Policy & Practice of Teachers &
Teacher Education (ISSN 2232-0458/ e-ISSN 2550-1771)
Vol. 8, No. 2, December 2018, 19-28

Factor structure of problem-solving efficacy among college Algebra students

Oscar C. Anoling Jr., Januard D. Dagdag*, Jefferson F. Pascual, Ryan P. Salviejo
Isabela State University, Philippines

Received: 5 Febuary 2018; Accepted: 1 September 2018; Published: 1 December 2018

Abstract

This paper discusses the development of the Problem – Solving Efficacy Scale on College Algebra. Through factor analytic research design, the scale underwent five development stages including assessment of factorability of the data, factor extraction, factor rotation and interpretation, rotation confirmation, and internal consistency analysis. In the 80 – item questionnaire administered to 80 randomly selected College Algebra students of Isabela State University, structural validity was attained with 34 scale items grouped into four components; namely, physiological/somatic responses, social persuasions, vicarious experiences, and mastery experiences. The developed instrument can explain 55.36% of the overall variance and has a high reliability coefficient ($\alpha = .87$), confirming that the four factors are integral to problem-solving efficacy in College Algebra. Physiological/Somatic responses and social persuasion explain greater amount of variance than mastery experience and vicarious which suggests that while teachers give importance on improving students' mastery level and modelling them with successful others in problem-solving activities in College Algebra, they should also encourage students to like the subject and see themselves successful in it, and provide them with sincere and timely encouragements especially problem-solving is a challenging learning tasks. College Algebra teachers should then design attainable learning goals coupled with challenging teaching-learning activities and constructively aligned assessment, and de-emphasize drills, speed tests, and competitions in problem-solving lessons.

Keywords: factor structure, efficacy, problem-solving, college algebra.

Introduction

The opening of the self-efficacy perspective on achievement behavior and applications of self-efficacy theory by Bandura (1997) has also opened a new and particularly rich avenue of inquiry on educational attainment. Self – efficacy, as defined by Bandura (1994), is the people's beliefs about their capabilities in producing required levels of performance that causes potential effect on their lives. Bandura (1994) argues that the efficacy of a person is determinant of the way the person feels, thinks, motivates himself/herself, as well as the way this person behaves. Furthermore, he theorized that a person's belief about his/her capabilities is able to produce diverse effects through processes that involve cognitive, motivational, affective, and selection process. Considering that self-efficacy beliefs are a determinant of one's feelings, thinking, motivation, as well as behavior, it is believed that those individuals who have high assurance about their capabilities consider difficult tasks as obstacles to be conquered and not threats to be avoided. In the academic setting, an individual's beliefs about his/her capabilities to utilize variety of learning strategies, his/her ability to resist distractions, complete coursework, participate in class have been found to influence academic achievement. This is what Klassen, Krawchuk, and Rajani (2008) calls self – efficacy for self – regulation. Students who have the ability to control their own study activities with self-efficacy and are able to develop appropriate self-learning styles have a higher chance of progressing and achieving better because non – self-regulated students are not that involved in the learning process

* Email: januard_15@yahoo.com

hence, they are susceptible to shallow knowledge and poor academic achievement. In a study conducted by Choo (2009), it is reported that deep and achieving approaches to learning is associated with strong self – efficacy beliefs. Furthermore, Ahmad et al (2014) conveyed that the belief of individuals about doing Mathematics can greatly influence the way they handle Mathematical tasks. In particular, Kung (2009) reported that there are evidences documenting the relationship between students' mathematics self-efficacy and mathematics achievement. To have a better and deeper understanding of this construct, it is therefore important to determine not only the level of problem-solving efficacy of Mathematics students but also the sources of their efficacy that include (1) mastery experience, (2) vicarious experience, (3) verbal persuasion, and (4) somatic/physiological reactions as theorized by Bandura (1997; 1994).

Mastery Experience

Mastery experiences are the "interpreted results of purposive performance". Pajares (2002) argues that the culminating activity in a learning situation would have been a "mastery experience". Mastery experience allows students to apply concepts as a proof of previous learning. Simply put, mastery experience is the result of one's previous learning or performance. This means that when students engage in learning activities, they interpret their actions and utilize these interpretations to develop beliefs of their ability to engage in subsequent tasks or activities. Among the four (4) sources, mastery experiences are considered to have a major effect on one's self-efficacy, hence, it is the most effective way to boost efficacy because one has the tendency to believe that he/she can do something new to him/her when he/she has done something similar in the past. However, the effect of mastery experience is also dependent on a person's belief of his/her skills or competencies. If people are able to convince themselves that they possess what it takes to succeed, they have the tendency to persevere in the face of a difficult situation (Bandura 1994). Sewell et al (2000) believes that the performance success of an individual provides an authentic evidence of whether he/she can bring about success or not. In other words, in classroom setting, if students experienced success in the past, they will probably believe that they can be successful at the same skill in the future. In particular, College Algebra students may believe that they can successfully solve problems when they know that they are equipped with the necessary skills in problem-solving. Also, if students have successful experience in doing College Algebra problems, there is a high tendency that they develop high regard of their abilities thus, making them believe that they can solve other problems they will be prompted to do in the future.

Vicarious Experience

Vicarious experience is concerned with "the effects produced by the actions of others". It is sometimes called modeling which refers to the positive influences of observing how other people succeed to efficacy beliefs (Hasan, Hossain, & Islam, 2014). Watching someone like yourself who is able to successfully accomplish a task increases your efficacy in accomplishing the same task. In other words, vicarious experience may be obtained through observing others who are similar to one's self (Brown, Malouff, & Schutte, 2005). On this context, Bandura (1995) emphasizes that the power of social modeling is dependent on two (2) factors: (1) the similarity of the person to the one he/she is observing and (2) the persevering attitude displayed by the model. He believes that the more similar the person is to the person being observed, the greater the influence of modeling and that the persevering attitude of the person being observed is more influential than his/her actual ability. This observation of others then eventually leads to an increase of self-efficacy through comparison. It means, therefore, that when a student sees another student successfully solve a mathematical task, the vicarious experience of observing a model has a strong influence on problem-solving efficacy. In addition to real-life models, Siegle (2000) asserts that watching video tapes of successful performance or watching photographs of past accomplishments can also increase student confidence. This shows that a student can have a vicarious experience not only through personally observing others but also through other media such as video tapes and pictures.

Social Persuasion

Social persuasion holds that when people are verbally persuaded that then can successfully do a task, they are more likely to succeed at doing the task. These "social messages" received from others goes a long way in supporting a person's belief in himself or herself (Brown et a, 2005). Conversely, when people are told they do not have the skill or ability, they tend to give up quickly and do not do the task (Bandura 1994). However, although verbal persuasion is important, its effect to self-efficacy is incomparable to mastery experience and vicarious experience. Hence, verbal persuasion must be coupled with actual successes to guarantee long-term effect (Hasan et la, 2000). Another key factor to consider is the credibility of the source of evaluative feedback or persuasion. When a person receives persuasion from someone he/she considers to be trustworthy, the tendency to develop higher self-efficacy is high (Sigle, 2000). In the school, when students view their teachers and peers to be knowledgeable and reliable, and the information is realistic, persuasive communication becomes effective (Hasan, Hossain, and Islam, 2014; Siegle, 2000). In conclusion, verbal persuasion can be a potential factor to be considered by teachers, parents, and peers. No matter how limited it is in its power to create strong and abiding self-efficacy, it is documented that encouragements from influential others tend to affect students' perceived ability. Hence, in the context of Mathematics classrooms, this source of self-efficacy gives us the idea that students may think that they can actually succeed in solving Mathematics problems, say in College Algebra, when they are encouraged by other people. Hence, they become persistent in solving problems which eventually leads to success.

Somatic/Physiological Responses

Physiological states refer to "anxiety, stress, arousal, fatigue, and mood". Bandura (1994) claims that when people judge their capabilities, they examine their somatic and emotional states. Consequently, they feel vulnerable to poor performance when they experience negative reactions. When people experience pains, aches, and fatigue, they often relate these to physical debility. Also, sweaty hands and dry mouth are often associated to nervousness. Such signs send indications of incapability t to students, thus affecting their efficacy. However, Hasan et al (2014) claims that even if students are confronted with new and situation if they are aware of being relaxed, they develop a higher sense of efficacy toward the task they face. With these, it is noteworthy that when College Algebra problems are viewed by students to be creating stressful situations, an emotional arousal is created. This, in turn, negatively affects the students' perceived self-efficacy in solving problems.

Considering that self – efficacy has a strong effect to one's choices, effort, and perseverance (Kung, 2009), it therefore plays a vital role in Mathematics classes (Zimmermann, Bescherer, Spannagel, 2010; Hannula, 2006; Pape & Smith, 2002). Particularly, the relationship between mathematics self-efficacy and mathematics achievement is well-documented (Pietsch, Walker, & Chapman, 2003; Zimmermann et al, 2010). In an academic environment, how a student learns problem-solving is greatly affected by self-efficacy. In fact, a correlation between academic success and self-efficacy has been found (Gore, 2006; Zajacova, Lynch, & Espenshade, 2005; Zimmerman, 2000). Therefore, the effect of self-efficacy belief in improving problem-solving skills is indispensable.

Being able to establish the relationship between perceived ability and performance in problem – solving could serve college and university programming efforts. Aside from this, the study will also serve as benchmark for teacher researchers, both from higher education institutions and basic education sector, who are interested in self-efficacy in general and problem-solving efficacy in particular. Also, researchers may also want to investigate on the role of self – efficacy in other disciplines such as in languages, science, and others. This study therefore was conceived by the researchers with the hope that it would allow the development of a reliable and valid scale to measure problem – solving efficacy of College Algebra students. While there are good empirical studies and theories supporting that high self – efficacy promotes better performance in problem-solving (Bandura, 1997; Hannula, 2006; Pape & Smith, 2002) a scale that is normalized in the context of higher education institutions in the Province of Isabela, Philippines and even beyond, is yet to be developed and validated.

Methodology

The study utilized a factor analytic research design to develop a valid and reliable scale that can measure the problem – solving efficacy of College Algebra students. The researchers decided to utilize this research design as a reduction method in order to uncover and establish the cause and effect relationship between the unobserved (latent) variables that are linked to self – efficacy. The respondents of the study are the eighty (80) students of the Isabela State University, a state university in the Philippines, who were randomly selected from among the students who were enrolled in College Algebra classes during the 2nd semester of Academic Year 2017 – 2018.

Initially, eighty (80) potential items were constructed and each scale item was based on a careful review of related literature. The scale items were formulated by the researchers and the same were subjected to the scrutiny of content and language experts not only to ensure that content validity is well established but also to determine whether or not the scale warrants that the items are comprehensive.

Upon considering the suggestions and comments of content and language experts, the instrument was pretested to a group of twenty – five (25) students to further enhance the validity (face) of the items. The participants during the pilot testing were asked to give their feedback as regards, but not limited to, the clarity of the direction, understandability of the words that are used as well as the totality of the individual scale items. After the incorporation of the suggestions and comments of the respondents, the instrument was revised. Finally, the revised instrument was again administered to a group of eighty (80) student respondents.

The gathered data served as the basis in the determination of the factor structure of the construct and in refining the scale. A series of factor analysis with the use of Principal Component Analysis was conducted with four distinct stages which include assessing the factorability of the data, determining the number of factors to be extracted, choosing the right rotation, rotating and interpreting the factor, and confirming the rotation used, to establish the structural validity of the scale. The aforementioned phases were undertaken to identify the minimum number of factors that can lead to the correlation between the variables under study. Finally, reliability analysis using Cronbach Alpha was performed to determine consistency of the scale.

Results and Discussion

Exploratory factor analysis (Principal Component Analysis) and reliability analysis (Cronbach Alpha) were used to characterize the factor structure of problem-solving efficacy in College Algebra.

Suitability of The Data

Upon recoding negative items, the suitability of the data for factor analysis was assessed. Initially, 3 items causing multicollinearity ($r > .90$) were deleted as factor analysis is sensitive to highly correlated items (Field, 2005). Moreover, Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of Sphericity were requested to determine the factorability of the data (Pallant, 2007; Tabachnick & Fidell, 2007). Literatures suggest that the KMO measure of sampling adequacy should be at least .50 (Field, 2005) and the Bartlett's test of Sphericity should be significant (Pallant, 2007) to warrant the use of factor analysis.

Although the assumption on sample size (150+) was not met (Pallant, 2007), the results of the KMO (.72) and Bartlett's tests ($\chi^2 =$ 5723.34; $p < .001$) suggest that the data were factorable (see Table 1).

Table 1. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.720
Bartlett's Test of Sphericity	Approx. Chi-Square	5723.340
	df	3120
	p	.000

Factors to be Extracted

Two methods, Kaiser Criterion and Scree test, were used to obtain the possible number of factors to be extracted. Kaiser's criterion retained 21 factors (eigenvalue > 1.0) while Catell's Scree test showed four factors (4 plots above the elbow of the Scree graph). Several literature criticize Kaiser's criterion for overestimating the number of factors (Pallant, 2007); hence, the result of the scree graph was tested and pursued (see Figure 1).

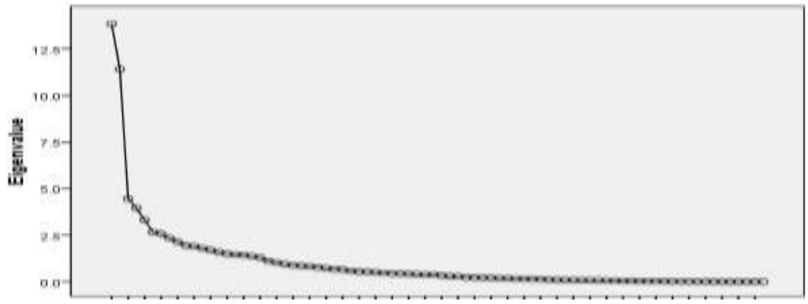

Figure 1. Scree Graph of the Items

Choosing the Right Rotation

To improve the interpretability of the factors through maximizing the number of items on every extracted factor, a rotation needs to be selected (Field, 2005). To choose the appropriate rotation, a four Factor analysis with Oblimin rotation was conducted. Requesting Oblique rotation (e. g. Direct Oblimin or Promax) is the best way to choose the right rotation as it provides information about the correlations between factors i.e. correlated factors (r> .32) warrants the use of Oblique rotation; otherwise, Orthogonal rotation such as Varimax, Quartimax, or Equimax (Tabachnick & Fidell, 2007; Brown, 2009b; Pallant, 2009; Field, 2005). The correlation of the factors ranges from 0.026 to 0.289 suggesting the appropriate use of Orthogonal Rotation (see Table 1).

Table 2. Component correlation matrix

Component	1	2	3	4
1	1.000	-.095	.117	-.026
2	-.095	1.000	.049	.289
3	.117	.049	1.000	.035
4	-.026	.289	.035	1.000

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Factor Rotation and Interpretation

Four factor analysis using PCA with Varimax orthogonal rotation and suppression of .40 or below coefficients was conducted. Twenty-five (23) items loaded in factor 1; 17 items went to factor 2; 14 items for factors 3; while only 10 items in factor 4. However, to refine the scale further, items with lower explanatory power and that are not related to the emerging theme in every factor were discarded. Thus, only 6 to 10 items were retained for each factor.

Table 3. Principal component analysis with Varimax Rotation

Scale Items	Component 1	2	3	4
63. I worry every time I am asked to solve College Algebra problems.	.849			
66. I am afraid of College Algebra problems.	.840			
72. College Algebra problems bring pressure to me.	.839			
65. I get nervous in my College Algebra class.	.826			
73. My hands are shaking when I am solving a problem in College Algebra.	.802			
62. I feel anxious when solving College Algebra problems because I know it's going to be difficult.	.777			
79. I cannot concentrate/focus while solving College Algebra problems.	.769			
75. I get a feeling of discomfort while solving a problem in College Algebra.	.758			
77. I see College Algebra problems as threats.	.740			
70. College algebra problems make me blush.	.723			
57. I am encouraged every time I receive positive feedback about my ability in problem-solving.		.826		
54. When others think that I can solve a problem in College Algebra, I develop the same line of thinking.		.764		
55. The encouraging words I receive from my friends help boost my confidence in problem-solving.		.746		
47. My eagerness to solve College Algebra problems successfully is heightened when other people believe in my ability to do so.		.742		
56. The belief of my friends that I can possibly succeed at problem solving makes me believe that I possess the necessary skills.		.727		
49. The support I receive from my teacher boosts my confidence in solving College Algebra problems.		.715		
41. When someone tells me that I can solve a College Algebra problem, my confidence is boosted.		.693		
42. I believe that my success or failure in solving Math problems largely depends on my capabilities and not on what other people say.		.644		
60. I feel a lot more able in problem-solving when someone is encouraging me.		.626		
52. If I receive praise from my teacher, I become eager to perform successfully in the future.		.597		
32. I am inspired to solve problems successfully when I watch video clips of successful performances.			.729	
29. Seeing documents of others' successes in problem-solving increase my confidence.			.676	
27. Videos or pictures of students succeeding in problem-solving lift my confidence.			.636	
25. The outputs of people whom I idolize boost my confidence.			.629	
23. I become eager to solve College Algebra problems successfully when my classmates are successful.			.582	
21. I think I am able to successfully solve College Algebra problems because my friends can.			.574	
34. I am challenged to solve College Algebra problems by the persistence of my friends.			.540	
36. When my teacher praises my classmates because of being able to solve a problem, I become eager to solve problems successfully, too.			.523	
3. I am confident I can solve College Algebra problems because of the skills I was able to develop in the past.				.732
7. I am certain I can solve College Algebra problems because I was able to master the skills in problem-solving.				.689
9. I am confident I can master the skills being taught in my College Algebra class.				.623
14. I believe I can solve College Algebra problems successfully because I know I possess the skills.				.570
12. I have mastered solving College Algebra problems that is why I will be able to deal with a problem set successfully.				.567
11. I am confident that I will be able to solve other College Algebra problems when I am able to solve a difficult one.				.547

The final PCA result is shown in Table 2. Generally, the four factors could explain 55.36% of the total variance. The explanatory power of the factors ranged from 5.8% to 21.49% (see Table 4).

Moreover, to label the four factors, the theoretical meaning of the items was evaluated. The items in Factor 1 referred to physiological responses such as anxiety and nervousness of solving College Algebra problems. Items in Factor 2 pertained to efficacy due to verbal persuasions by friends, classmates, or teachers. Items in Factor 3 reflected efficacy by observing successful others. Items in Factor 4 captured efficacy by possessing mastery. Hence, the factors were labeled as

Physiological/Somatic Responses, Verbal Persuasions, Vicarious Experience, and Mastery Experience, respectively.

Rotation Confirmation

Oblimin rotation was re-run to check the appropriateness of using orthogonal rotation instead of oblique rotation (see Table 3). Results confirmed that the four factors were really uncorrelated and independent, thus, justifying the appropriate use of Varimax.

Table 4. Component correlation matrix

Component	1	2	3	4
1	1.000	-.046	.254	.179
2	-.046	1.000	.103	-.090
3	.254	.103	1.000	.230
4	.179	-.090	.230	1.000

Note. Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Internal Consistency

Cronbach Alpha was used to assess how well factors and the items on each factor go together. As shown in Table 4, all the factors attained reliability whose coefficients ranged from .734 to .936. Hence, the scale as a whole is reliable (α = .872).

Table 5. Variance explained and internal consistency of the scale

Scale	*n*	R^2 (%)	Cronbach Alpha
Physiological/Somatic Responses	10	21.49	.936
Verbal Persuasion	10	19.63	.902
Vicarious Experience	8	8.45	.808
Mastery Experience	6	5.80	.734
Problem-Solving Efficacy	34	55.36	.872

Note. *n* refers to the number of scale items

Discussion

This paper reports on the development of the Problem-Solving Efficacy Scale in College Algebra. With the help of experts, 80 scale items were formulated which were piloted and revised, then administered to 80 respondents.

The development of the scale was strictly guided by literature and underwent systematic and justifiable processes. Firstly, the suitability of the data was assessed through checking the assumptions suggested by literatures. Assumptions on Communalities and ratio of items to variable were both met. Secondly, the number of factors was investigated and scree plot showed four factors. Thirdly, Four-factor analysis with Oblimin rotation was conducted to determine the right rotation; and since the factors were uncorrelated, Varimax rotation was chosen. Fourthly, the four factors were rotated using Varimax and retained only 33 fit (with high coefficients) and relevant items, which could explain a total of 55.36% of the overall variance. The items of each factor were interpreted based on their theoretical meaning. Subsequently, Oblimin rotation confirmed the suitability of using Varimax rotation since the factors were found independent between one another. Finally, a reliability analysis using Cronbach alpha established the reliability of the scale $(\alpha = .85)$.

However, the findings on which factor contributes the greatest variance did not support previous literatures; and this makes the scale unique. Unpredictably, physiological/somatic responses (21.49%) and social persuasions (19.63%) share the greatest variance while the other two factors contribute the smallest amount of variance; which suggests that the college algebra students associate their problem-solving efficacy mostly with anxiety and praises or encouragement from others, rather than their vicarious experiences and level of mastery. This has implication to students who are not confident in solving algebra problems despite reaching a satisfactory level mastery and relevant vicarious experiences in Algebra. This situation might be largely influenced by their mathematics anxiety and/or the verbal reinforcements they get from others. On the other hand, this has implication to teachers who focus extensively on developing students' mastery and continually model them with successful others. While these efforts are essential in building problem-solving efficacy, teachers should also seek effective ways to lessen students' math anxiety. They should encourage students to like math and see themselves successful in it (Furner & Berman, 2003) by designing attainable learning goals coupled with challenging teaching-learning activities (Cruikshank & Sheffield, 1992) and constructively aligned assessment (Dagdag & Cardona, 2018), and de-emphasizing conventional approaches such as drills, speed tests, and competitions (Dagdag & Cardona, 2018; Reys, Suydam, & Lindquist, 1995). Similarly, they should provide them with sincere and timely praises/encouragements especially problem-solving is a very challenging learning tasks (Maclellan, 2005).

The abovementioned lead to the conclusion that if educators really want to help students improve their achievement in Algebra, they should first build a learning environment and learning culture that do not only focus on successful performance in problem-solving but also enhances students' problem-solving efficacies in terms of physiological/somatic responses, social persuasions, vicarious experiences, and mastery experiences (Pietsch et al, 2003). Pursuing such will also improve learning habits which might lead students to academic success (Gore, 2006; Zajacova et al, 2005; Zimmerman, 2000).

This study is noteworthy as it starts to develop and validate an instrument which can be used by higher education institutions in the Province of Isabela, Philippines. It provides teachers and researchers of the province with an economical yet valid and reliable scale that can measure students' efficacies in solving algebra problems. Although much have been explored about problem-solving efficacies, normalizing an efficacy scale focusing on Algebra in this context is not a common one. Hence, this study contributes to the enrichment of literatures both in the research area and the context by establishing a tool that offers opportunities for future studies.

However, the scale was only normalized among the 80 randomly selected college algebra students in Isabela Province and the factors were refined through an exploratory factor analysis. Future research may consider testing the scale to different and wider context as well as using confirmatory factor analysis to refine further the quality of the scale. But then, the currently developed material can already be used in a quantitative research in the context of Isabela Province to validly and reliably measure the problem-solving efficacy of students in College Algebra class. Other researchers in the same field may also adopt and contextualize the scale for their study provided they will ask consent from the current researchers and will cite this study.

References

Ahmad, A., Saad, N.S., Ghani, S.A. (2014). Mathematical problem-solving behabior of successful problems-solvers. *Journal Pendidikan Bitara UPSI,* 4 (2), 1 – 13.

Bandura, A. (1994). Self-efficacy. *Encyclopedia of Human Bahavior,* 4, 71 – 81.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Bandura, A. (2004). Swimming against the mainstream: The early years from chilly tributary to transformative mainstream. *Behavior Research and Therapy,* 42, 613 – 630.

Brown, J. D. (2009b). Statistics Corner. Questions and answers about language testing statistics: Choosing the right number of components or factors in PCA and EFA. *Shiken: JALT Testing & Evaluation SIG Newsletter*, 13(3), 20 – 25.

Brown, L.J., Malouff, J.M., & Schutte, N.S. (2005). The effectiveness of a self-efficacy intervention for helping adolescents cope with sport-competition loss. *Journal of Sport Behavior*, 28 (2), 136 – 150.

Choo, G.S. (2009). Preliminary study of approaches to learning and teaching self-efficacy of student-teachers in Malaysia. *Journal Pendidikan Bitara UPSI,* 2 (1), 14 – 28.

Choi N. (2005). Self-efficacy and self-concept as predictors of college students' academic performance. *Psychology in the Schools,* 42: 197 – 205.

Cruikshank, D. E. & Sheffield, L. J. (1992). *Teaching and learning elementary and middle school mathematics*. New York: Merrill, 24.

Dagdag, J. D. & Cardona, R. S. (2018). Perspectives and practices on outcomes-based assessment (OBA) among college mathematics educators in Northeastern Luzon, Philippines. *Asia Pacific Journal of Multidisciplinary Research*, 6(2), 18-25.

Field, A. P. (2005). *Discovering statistics using SPSS* (2nd ed). London: Sage.

Furinghetti, F., & Pehkonen, E. (2002). Rethinking characterizations of beliefs. In G. C. Leder, E. Pehkonen, & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education* (pp. 39 – 57). Dordrecht, The Netherlands: Kluwer.

Furner, J. & Berman, B. (2003). Math anxiety: Overcoming a major obstacle to the improvement of student math performance (Electronic Version). *Association for Childhood Education International*. Spring 2003.

Gore, P. (2006). Academic self-efficacy as a predictor of college outcomes: Two incremental validity studies. *Journal of Career Assessment*, 14 (1), 92 – 115.

Hannula, M. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics*, 63, 165 – 178.

Hasan, M., Hossain, T, & Islam, A. (2014). Factors affecting self-efficacy towards academic performance: A study on polytechnic students in Malaysia. *Advances in Environmental Biology*, 8 (9), 695 – 705.

Klassen R.M., Krawchuk, L. L., Rajani, S. (2008). Academic procrastination of undergraduates: Low self-efficacy to self-regulate predicts higher levels of procrastination. *Contemporary Educational Psychology*. 33, 915 – 931.

Kung, H. (2009). Perception or confidence? Self-concept, self-efficacy and achievement in mathematics: A longitudinal study. *Policy Futures in Education*, 7, 387 – 398.

Leder, G. C., Pehkonen, E., Törner, G., & ebrary Inc. (2002). Beliefs a hidden variable in mathematics education? Mathematics education library v 31 Retrieved April 26, 2018 from http://www.columbia.edu/cgi-bin/cul/resolve?clio5394427

Linnenbrink, E.A., & Pintrich, P.R. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading and Writing Quarterly*, 19 (2), 119 – 137.

Mclellan, E. (2005). Academic achievement: The role of praise in motivating students. *Active Learning in Higher Education*, 6 (3), 194 – 206. DOI: 10.1177/1469787405057750

Nunnally, J. O. (1978). *Psychometric theory*. New York: McGraw-Hill.

Nunnally, J. & Bernstein, I. (1994). *Psychometric theory*. New York: McGraw-Hill.

Op 't Eynde, P., De Corte, E., & Verschaffel, L. (2002). Framing students' mathematics-related beliefs. A quest for conceptual clarity and a comprehensive categorization. In G. C. Leder, E. Pehkonen, & G. Törner (Eds.), *Beliefs: A hidden variable in mathematics education?* (pp. 13 – 37). Dordrecht: Kluwer Academic Publishers.

Pallant, J. (2007). *A step-by-step guide to data analysis using SPSS for Windows: SPSS survival manual* (3rd edn). Open University Press. McGraw Hill

Pajares, F. (2002). Self-efficacy beliefs in academic contexts: An outline. Retrieved April 26, 2018 from http://des.emory.edu/mfp/efftalk.html.

Pape, S. J., & Smith, C. (2002). Self-regulating mathematics skills. *Theory into Practice*, 41, 93 – 101.

Pietsch, J., Walker, R. & Chapman, E. (2003). The relationship among self-concept, self-efficacy, and performance in mathematics during secondary school. *Journal of Educational Psychology*, 95, 589 – 603.

Reys, R. E., Suydam, M. N., & Lindquist, M. N. (1995). *Helping children learn mathematics*. Boston: Allyn & Bacon.

Rowbotham M., Schmitz G.S. (2013). Development and Validation of a Student Self-efficacy Scale. J Nurs Care 2: 126. doi:10.4172/2167- 1168.1000126

Siegle, D. (2000). *What influences self-efficacy?* Retrieved July 2, 2018 from https://nrcgt.uconn.edu/underachievement_study/self-efficacy/se_section2/#

Tabachnick, B. G. & Fidell, L. S. (2007). *Using multivariate statistics* (5th edn). Boston: Pearl Education

Zajacova, A., Lynch, S., & Espenshade, T. (2005). Self-efficacy, stress, and academic success in college. *Research in Higher Education*, 46 (6), 677 – 700.

Zimmerman, B.J. (2000). Self-efficacy: An essential motivation to learn. *Contemporary Educational Psychology*, 25, 82 – 91.

Zimmermann, M., Bescherer, C., Spannagel, C. (2010). *A questionnaire for surveying mathematics self-efficacy expectations of future teachers.* Retrieved February 20, 2018 from the German Federal Ministry of Education Website: http://www.cerme7. univ.rzeszow.pl/WG/14/CERME7-WG14-Paper---Zimmermann,-Bescherer -&-Spannagel-REVISED-Dec2010.pdf