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Research Paper

Motivation to Contextualize Mathematics, Self-determination, Intrinsic Motivation, and Self-efficacy: A PLS-SEM

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Abstract

This study investigates the concrete relationship among the motivation to contextualize mathematics, self-determination, intrinsic motivation, self-efficacy. The study was conducted in J.H. Cerilles State College. It further shows that intrinsic motivation mediates between motivation to contextualize mathematics and self-efficacy. This study utilizes a descriptive-correlational research design and measured using PLS-SEM (Partial Least Squares – Structural Equation Modeling) to evaluate the proposed model of constructs. Moreover, the level of significance was measured with p-value of 0.05. It was revealed that self-determination significantly and positively affects Intrinsic Motivation and Self-efficacy. Additionally, motivation to contextualize mathematics and intrinsic motivation have a direct relationship and significant effect towards self-efficacy. Intrinsic motivation mediates the relationship between self-determination and self-efficacy and also between motivation to contextualize mathematics and self-efficacy.

Keywords *Motivation to Contextualize Mathematics; Self-determination; Intrinsic Motivation; Self-efficacy; Structural Equation Modeling*

INTRODUCTION

The Programme for International Student Assessment (PISA) by the Organization for Economic Cooperation and Development (OECD) reported that students participated from Philippines scored only 353 in Math which is lower than the global average score of 489 (PISA National Report of the Philippines, 2018). Many researches have also revealed that students in Philippines hated math subject so grievously. In addition, attrition rates of college students increased in Science, Mathematics, and Engineering areas caused by poor classroom instruction in High School (Strenta et al., 1999; Seymour & Hewitt, 1997; Daempfle, 2002). In the study of Altun and Akkaya (2014) about Programme for International Student Assessment (PISA) that problems in Mathematics are often presented and given using a real-world scenario. Students maybe good at concepts but whenever they would come across with problems that involved real-world scenarios they would always cramp with anxiety. In order to address this issue, math problems should be taught and delivered using contextualization approach to give students a chance to conceptualize ideas and relate them to their environment for them to become a better problem solver (Wright, 2001). Students can be comfortable with problems that can be related to real-world situation and oftentimes consider algebra as a difficult are in the field of mathematics than geometry as there are more daily life examples (Gafoor % Kurukkan, 2015).

On the other hand, many students hated math is because of the way they are taught. It was reported that out of 51 students, 85% of the students do not like mathematics and 63% find it boring (Gafoor & Kurukkan, 2015). One main reason for low mathematical participation among students in mathematics is due to lack of self-efficacy (Brown, Brown & Bibby, 2018). Self-efficacy is defined as a person's belief to perform and fulfil a task. A high degree of self-efficacy could cause people to work hard and continue to accomplish tasks depite tough circumstances (Heslin & Klehe, 2006). In addition, contextualization can be utilized as a teaching strategy to strengthen self-efficacy (Bandura, 1997). Contextualization can impact intrinsic motivation and it is correlated with self-efficacy (Clancey, 1993; Gazzaniga, 1995; Zimmerman, 1997). Contextualization is one of the teaching strategies that can foster learner's critical thinking which is essential in the 21st century skill learners.

Moreover, the factors are mainly anchored on the study of Krause et. al (2016), the motivation to contextualize mathematics and the significant effects of contextualization of contents in the classroom setting wherein they stated that students learning can be improved when students bring their own experiences to the classroom as prior knowledge and connect concepts to the real-world situations. They added also that the implementation of this teaching strategy should be realized in the classroom setting. Students are very much capable in learning whenever they are given a chance to make advantage of their prior knowledge learned from the outside world. Moreover, contextualization can improve student's motivation, learning, and persistence.

Cordova and Lepper (1996) linked contextualization to intrinsic motivation and showed evidences that students displayed willingness to learn concepts which in turn can augment intrinsic motivation of the students whenever they are given an opportunity to experience a contextualized classroom atmosphere. In addition, a study published by Lepper and Malone (1987) described that intrinsically motivated students will manifest good performances towards their academics. While if students are self-determined to do task, they would have a tendency to be intrinsically motivated in learning concepts (Deci & Ryan, 2000). As defined by Ryan et. al (1997) that self-determination is a method of psychological self-regulation whereby there is an individual motivation to develop innermost assets for personality progress.

On the other hand, self-efficacy can be impacted by contextualization because contextualization can be used as assessment to examine self-efficacy (Bandura, 1997). As defined by Bandura (1997) that self-efficacy is a reliance to accomplishing different tasks while grasphing the ideas and concepts with total confidence. In addition to this, it has been confirmed from this study that students are determined to fulfil tasks and become motivated if they have high level of self-efficacy. S.H. (2002) mentioned that the computer diagnostic test was administered to test students' level of self-efficacy and found that the level of students' self-efficacy was significantly high when they were allowed to relate abstract concept to real-world problems and through contextualization their intrinsic motivation, task involvement, self-efficacy, and learnings were improved and promoted. Self-efficacy and Intrinsic Motivation have a connection as found by Zimmerman (1997). This was supported by Bandura (1997) that intrinsic motivation should be converted to attain the true knowledge he mentioned.

Furthermore, students' self-determination has an effect to self-efficacy wherein students are willing and motivated to do tasks and are personally developed in learning abstract concepts (Ryan, Kuhl, & Deci, 1997; Sacdalan & Bozkus, 2018). However, there are limited studies found that motivation to contextualize mathematics can augment intrinsic motivation, and intrinsic motivation can develop self-efficacy. While some evidences presented that self-determination has a direct relationship to intrinsic motivation. Through further reading, numerous published studies lack evidences on the concurrent effects and interrelationship of these variables. Hence, the study was conceptualized to investigate the structural model among motivation to contextualize

mathematics, self-determination, intrinsic motivation, and self-efficacy of J.H. Cerilles State College students specifically in the School of Teacher Education (STE) and School of Engineering and Technology (SET) department who took up mathematics subjects or any math-related subjects.

LITERATURE REVIEW

Motivation to Contextualize Mathematics

Contextualization has been characterized as a various group of instructional techniques configuration to all the more consistently connect the learning of basic aptitudes and educational or career-related content by centering teaching and learning on abstract applications in a particular setting that is important to the students (Mazzeo, Rab, & Alssid, 2003; Perin, 2011). Additionally, contextualization has been a part of the teaching strategy which allowed learners to promote their learning abilities. However, the need to improve teacher's knowledge upon integrating real-world problems is really important in promoting student's learning (Paris, 2011; Reyes, 2019).

Mouraz & Leite (2013) stated that many published studies aimed to propose contextualization in various areas of learning and putting students' knowledge into real-world problems to make them appreciate the value of learning some abstract concepts.

Self-determination

Ryan & Deci (2000) defined self-determination as a method that applies the organismic meta-theory that points out the significance of an individual that develops innermost assets for personality progress and psychological self-regulation wherein it makes use of conventional procedure towards individual motivation. Moreover, Denney & Daviso (2012), asserted that self-determination comprises cognitive, affective, and behavioral components in which it is a student's competence to specify and accomplish aims based on the relation of principles originating independently.

Intrinsic Motivation

Intrinsically motivated students take part for their own goal and often attracts task that captivates their interest and completes the task with their own will with an entire sense of desire without looking forward to any rewards (Bye, 2012). Besides, exploration, impulsive interest, mastery, and understanding are crucially needed for intellectual and social progress wherein it constitutes a fundamental point of liveliness and happiness in life and all of it is expressed by establishing intrinsic motivation (Ryan & Deci, 2000). The use of appropriate strategies in teaching using varied materials and addition of a meaningful context will make students enjoy in accomplishing a task. Thus, making them intrinsically motivated in term of how they learn. Moreover, if students were exposed to great extent of embellished activities, they may display higher levels of intrinsic motivation (Cordova & Lepper, 1996). Furthermore, anchored on the study of DeCharms (1998) and Ryan & Deci (2000) equates intrinsic motivation to self-determination. Thus, people were regarded as the actors of their own fate because they control their choices whenever they are in a contextualized setting. It just means that learning would be enjoyable and meaningful if students were given a chance to persist in their learning based on their own control because they can relate concepts to their environment.

Self-efficacy

As defined by Bandura (1997) and Zulkosky (2009), self-efficacy is a human reliance or cognition with regard to their inability in mathematics. On the other hand, accomplishing different tasks while comprehending the ideas in answering the given mathematical problems with confidence is considered as individual mathematics self-efficacy. In general, it has been confirmed that students are determined to complete the given task and motivated to absorb the concepts presented compared to their peers if they have a high level of self-efficacy (Zeldin & Pajares et. al, 2008). Contextualized approach can be used as assessment to self-efficacy which in turn produce a

specified levels of performance (Bandura, 1997; Weitlauf et.al, 2001).

RESEARCH METHOD

This study was carried out to determine the interrelationship of Motivation to contextualize Mathematics and Self-determination towards Intrinsic Motivation and Self-efficacy and how it affects each other. This study also investigates the Intrinsic Motivation, Self-efficacy, and Self-determination of STE students who were taking up Mathematics subject at J.H. Cerilles State College. Moreover, it showed the interconnection among the four variables and how they affect each other. The Motivation to contextualize Mathematics has a direct relationship towards Intrinsic Motivation and it was proved by Cordova and Lepper (1996) wherein they mentioned that contextualization can aid students to increase their Intrinsic Motivation.

On the other hand, Self-determination and Intrinsic Motivation have also direct relationship that was asserted in the study of Deci and Ryan (2000) wherein they stated that Self-determination fostered Intrinsic Motivation when students are set in a contextualized event. It is also in Figure 1 that there is a direct relationship between Intrinsic Motivation and Self-efficacy and it was proved by Zimmerman (1997) and found that there was a high correlation between the two. Moreover, there is an indirect relationship between Self-determination and Self-efficacy wherein it has a mediator and it was found in the study of Sacdalan & Bozkus (2018). The researchers want to investigate the concurrent relationship among the variables being studied and hypothesize a model based on the theories under study. The following are to be answered in this study:

1. Does the Motivation to contextualize Mathematics positively affect Intrinsic Motivation?
2. Does the Motivation to contextualize Mathematics positively affect Mathematics Self-efficacy?
3. Does the Self-determination positively affect Intrinsic Motivation?
4. Does the Self-determination positively affect Self-efficacy?
5. Does the Intrinsic Motivation positively affect Self-efficacy?
6. Does Intrinsic Motivation mediate the relationship between Motivation to contextualize Mathematics and Self-efficacy?
7. Does Intrinsic Motivation mediate the relationship between self-determination and self-efficacy in Mathematics?

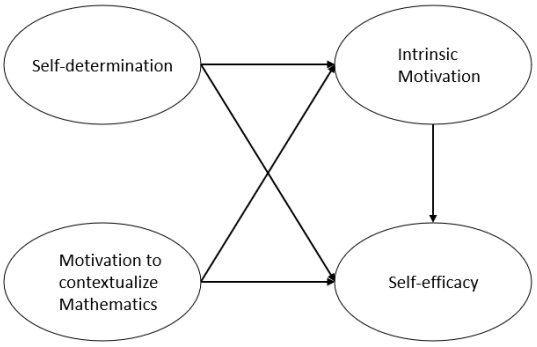

Figure 1: Hypothesized Structural Model on Motivation to contextualize Mathematics, Self-determination, Intrinsic Motivation, and Self-efficacy

This study is a descriptive-correlational and causal-comparative designs using Partial Least Squares – Structural Equation Modeling (PLS-SEM). The descriptive method aims to investigate, examine, and summarize information about the relationship of Motivation to contextualize

Mathematics, Self-determination, Intrinsic Motivation, and Self-efficacy. The correlational approach determined the interconnection and significant relationship among the variables. Moreover, the hypothesized structural model will be evaluated by extended regression which measures the goodness of fit using Partial Least Squares – Structural Equation Modeling (PLS-SEM) approach to evaluate the degree to which the data support the proposed theoretical model. A PLS-SEM is a variance-based estimation method (Reinartz, Haenlein, & Henseler, 2009) which assesses the reliability and validity of the contructs and estimates the relationship between these measures (Barroso, Carrion, & Roldan, 2010). This study also using the WarpPLS 6.0 software for the data analysis.

In addition, the parameter estimation method Maximum Likelihood (ML) was used as a fitting function for the structural equation models. The cross-sectional approach of gathering the data will employ measuring the quantitative levels of motivation to contextualize mathematics, self-determination, intrinsic motivation, and self-efficacy through a Likert scale questionnaire. The adopted Likert scale questionnaires elicit the self-reported perceptions of the respondents with higher values indicating higher positive responses on item scales.

The study was conducted at J.H. Cerilles State College – Main Campus situated at Brgy. Mati, San Miguel Zamboanga del Sur. It is located between Municipality of Lapuyan and Municipality of Guipos, Zamboanga del Sur along National Highway.

The researchers utilized a purposive sampling in selecting the respondents of the study. Students who have mathematics courses where intentionally selected. Using the minimum absolute significant path coefficient of 0.205, significance level of 0.05 and power level of 0.80, the results of the sample size estimation are 148 for the inverse square root method and 134 for the gamma-exponential method. Hence, the actual sample size of 214 is sufficient enough to explain the results of the structural model.

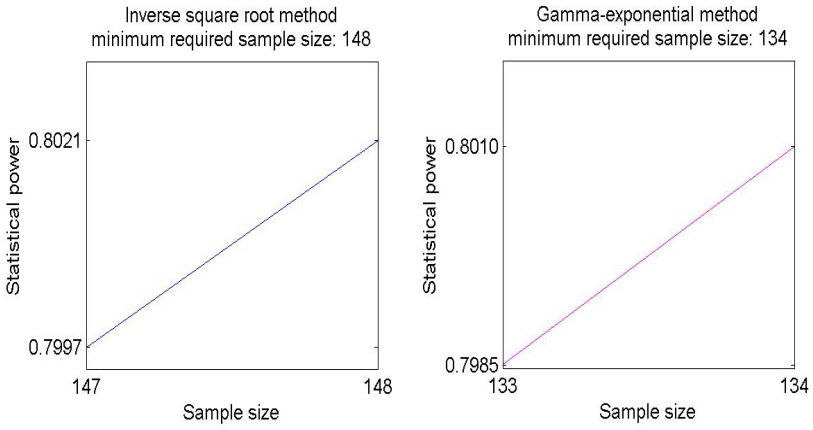

Figure 2. Sample size estimates based on Inverse Square Root and Gamma-exponential methods

The participants of the study were the students of J.H. Cerilles State College who were taking up math-related subjects specifically students from the School of Teacher Education (STE) and School of Engineering and Technology (SET). There was no gender restriction of the respondents. The respondents of the study were those students who were attending school at the J.H. Cerilles State College – Main Campus only. However, there is a number of respondents restriction and the study utilized at least 200 respondents tested.

Table 1

		n	%
Gender			
	Male	78	36.4
	Female	136	63.6
Age			
	18	24	11.21
	19	79	36.92
	20	53	24.77
	21	36	16.82
	22	13	6.07
	23	1	0.47
	27	3	1.40
	30	3	1.40
	31	1	0.47
	33	1	0.47
Department			
	STE	98	45.8
	SET	116	54.2
Total		214	100

The primary instrument of this study were a Likert-scale questionnaires with multiple items to measure the theoretical contructs with higher values indicating higher positive responses to the item scales.

The Motivation to contextualize Mathematics was measured using a four-point Likert-scale adopted from Krause et. al (2016). The Motivation to contextualize Mathematics was measured using a 4-point Likert-scale questionnaire containing 4 responses namely: (4) Strongly agree, (3) Agree, (2) Disagree, and (1) Strongly disagree. The positive responses are ranked from 4 to 1 and the negative responses are in reverse code. The adopted questionnaire has 24-item questions containing how students contextualize Mathematics concepts.

The Self-determination was measured using a five-point Likert-scale adopted from American Institute for Research (AIR) through the study of Wehmeyer (1995) who developed the AIR Self-determination. The Self-determination level was measured using a 5-point Likert-scale questionnaire containing 5 responses namely: (5) Always, (4) Almost always, (3) Sometimes, (2) Almost never, and (1) Never. The positive responses are ranked from 5 to 1 and the negative responses are in reverse code. There are 24-item questions which were categorized in 4 classifications namely: (1) Things I do, (2) How I feel, (3) What happens at school, and (4) What happens at home.

The Intrinsic Motivation was measured using 3-point Likert-scale adopted from Mcauley, Duncan and Tammen (1987). The Intrinsic Motivation was measured using a 7-point Likert-scale questionnaire containing 7 responses namely: (7) Very true, (6) True, (5) Significantly true, (4) Almost true, (3) Somewhat true, (2) Not much true, and (1) Not true at all. The adopted scale questionnaire has 22-item questions and it was classified into 4 subscales namely: Interest/Enjoyment, Perceived Competence, Perceived Choice, and Pressure/Tension.

The Self-efficacy was measured using 5-point Likert-scale adopted from the study of Gaumer et. al (2018). The Self-efficacy level was measured using 5-point Likert-scale questionnaire containing 5 responses namely: (5) Very much like me, (4) Mostly like me, (3) Somewhat like me, (2) Not much like me, and (1) Not like me at all. The positive responses are ranked from 5 to 1 and the negative responses are in reverse code. There are 10-item questions and it was categorized into 2 subscales namely: Belief in personal ability and Belief that ability grows with effort. Belief in personal ability is contained in item 1 to 8 and Belief that ability grows with effort is contained in item 9 to 13 with an items of 13 all in all. The response in positive

statements had a weighted score of 5, 4. 3, 2, and 1 while negative statements are ranked in reverse code.

FINDINGS AND DISCUSSION

Levels of Students' Motivation to Contextualize Mathematics

Results in Table 1 showed that the respondents generally obtained a *high level* in their Motivation to Contextualize Mathematics (M=3.03, SD=0.3). They perceived that contextualizing mathematics is a good way to build their future career goals. Additionally, based from the findings the respondents also affirmed that contextualizing mathematics is not a distracting approach that they can utilize effectively and that it will not hamper their learnings in mathematics topics. Besides, students can also gain a better knowledge of abstract ideas and improve their comprehension in math and achievement. As well as students can also use this method to collaborate with their classmates and foster friendliness.

Moreover, the results display that the students have a *very high level* of motivation to contextualize mathematics (M=3.26, SD=0.5) using the contextualization approach as an effective strategy to aid their learning in mathematics. Furthermore, the results also revealed that students have a *moderate* level of motivation to contextualize mathematics (M=2.36, SD=0.74) as contextualization is not a suitable strategy in dealing with mathematics subject. Thus, it implies that students found contextualization method as better practice in studying mathematics.

Generally, students can construct meaningful mathematical knowledge whenever they displayed higher level of motivation towards contextualizing mathematics (Valenzuela, 2018) which is essential to comprehending abstract concepts in mathematics. Contextualization on the other hand is another method in improving the content in mathematics activities (Castek & Goss, 2010). In addition, delivering the lesson using a real-life setting considerably promotes student learning (Center for Occupational Research and Development, 2012).

Table 2 Descriptive levels of students' motivation to contextualize mathematics (n=214)

	M	SD	QD
1. This strategy will not be distracting to me.	3.14	0.59	H
2. I will be able to use this strategy effectively.	3.19	0.52	H
3. Using this strategy I will not make the class chaotic.	3.06	0.55	H
4. There is an adequate amount of my classmates in the class to implement this strategy effectively.	3.06	0.45	H
5. Using this strategy will aid my ability to learn.	3.26	0.5	VH
*6. This strategy will not be inappropriate for mathematics subject.	2.36	0.74	M
7. This strategy will work with my fellow classmates.	3.18	0.5	H
8. The set-up of mathematics the class will be appropriate for using this strategy.	3.14	0.5	H
9. Use of this strategy will not hinder my learning in mathematics subject.	3.1	0.55	H
10. Using this strategy will aid my career goals.	3.17	0.49	H
11. This strategy will be a valuable instructional approach that can be used in mathematics subject.	3.16	0.48	H
12. The use of this strategy will help me obtain a deeper understanding of the concepts in mathematics.	3.18	0.47	H
13. Using this strategy will promote friendliness among my classmates.	3.09	0.46	H
14. This strategy is aligned with the goals of my program.	3.14	0.47	H

	M	SD	QD
15. Using this strategy will help foster a positive attitude towards learning.	3.16	0.45	H
16. This strategy will be of value to me in my future classes.	3.19	0.51	H
17. Using this strategy will increase my comprehension and achievement in mathematics subject.	3.2	0.49	H
18. Using this strategy will motivate me in doing task in mathematics subject.	3.2	0.49	H
19. The effort involved in using this strategy will not be too great.	2.65	0.69	H
20. It will not be difficult to use this strategy.	2.94	0.5	H
21. Without a technology assessment, it will be easier for me to use this strategy.	2.67	0.65	H
22. Using this strategy will not cause me frustration.	2.9	0.56	H
23. An appropriate amount of doing the task will be consumed to use this strategy.	2.93	0.51	H
24. Using this strategy will not require too much interaction with my fellow classmates.	2.73	0.65	H
Overall	3.03	0.3	H

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.74 = Very Low (VL), 1.75 – 2.49 = Moderate (M), 2.50 – 3.24 = High (H), 3.25 – 4.00 = Very High (VH)

Levels of Students' Self-determination

The Self-determination of the students was measured using a five-point likert-scale questionnaire adopted from American Institute for Research (AIR) through the study of Wehmeyer (1995) who developed the ARC Self-determination. A high level students' self-determination is allied with high level of response on the questionnaire's item indicators.

Table 3. Descriptive levels of students' self-determination (n=214)

	M	SD	QD
THINGS I DO	4.03	0.66	H
1. I know what I need, what I like, and what I'm good at.	4.05	0.88	H
2. I set goals to get what I want or need. I think about what I am good at when I do this.	4.06	0.84	H
3. I figure out how to meet my goals. I make plans and decide what I should do.	4.06	0.84	H
4. I begin working on my plans to meet my goals as soon as possible.	4.07	0.84	H
5. I check how I'm doing when I'm working on my plan. If I need to, I ask others what they think of how I'm doing.	3.86	0.93	H
6. If my plan doesn't work, I try another one to meet my goals.	4.1	0.93	H
HOW I FEEL	4.16	0.66	H
7. I feel good about what I like, what I want, and what I need to do.	4.21	0.82	VH
8. I believe that I can set goals to get what I want.	4.17	0.82	H
9. I like to make plans to meet my goals.	4.29	0.82	VH
10. I like to begin working on my plans right away.	3.99	0.88	H
11. I like to check on how well I'm doing in meeting my goals.	4.03	0.83	H
12. I am willing to try another way if it helps me to meet my goals.	4.28	0.83	VH
WHAT HAPPENS AT SCHOOL	3.61	0.74	H
13. People at school listen to me when I talk what I want, what I need, or what I'm good at.	3.41	0.87	H
14. People at school let me know that I can set my own goals to get what I want or need.	3.37	0.93	M
15. At school, I have learned how to make plans to get my goals and to feel good about them.	3.95	0.92	H
16. People at school encourage me to start working on my plans right away.	3.82	0.98	H
17. I have someone at school who can tell me I am meeting my goals.	3.51	1.05	H

	M	SD	QD
18. People at school understand when I have to change my plan to meet my goals. They offer advice and encourage me when I'm doing this.	3.62	1.01	H
WHAT HAPPENS AT HOME	3.85	0.88	H
19. People at home listen to me when I talk about what I want, what I need, or what I'm good at.	3.79	1.02	H
20. People at home let me know that I can set my own goals to get what I want or need.	3.85	1.01	H
21. At home, I have learned how to make plans to meet my goals and to feel good about them.	3.94	0.91	H
22. People at home encourage me to start working on my plans right away.	3.88	1.03	H
23. I have someone at home who can tell me if I am meeting my goals.	3.78	1.09	H
24. People at home understand when I have to change my plan to meet my goals. They offer advice and encourage me when I'm doing this.	3.85	1.06	H
Overall	3.91	0.61	H

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.79 = Very Low (VL), 1.80 – 2.59 = Low (L), 2.60 – 3.39 = Moderate (M), 3.40 – 4.19 = High (H), 4.20 – 5.00 = Very High (VH)

Table 3 reports the results of Self-determination (M=3.91, SD=0.61). Self-determination is classified into four subdomains namely Things I do, How I feel, What happens at school, and What happens at home. Students tend to display high level of awareness in setting goals and they build their guts to monitor their progress to make things succeed wherein it was revealed in Things I do (M=4.03, SD=0.66). Moreover, students manifested a high level of confidence in How I feel (M=4.16, SD=0.66) towards formulating plans and they will likely take a risk just to fulfil what they plan to accomplish, they also shift plans whenever they feel it would fail at first.

Futhermore, the levels in *What happens in school* (M=3.61, SD=0.47) is relatively *high* that revealed students' learning on how to build a plan and they are often encouraged by their teacher to pursue what they plan to do. Similarly, in the result of *What happens at home* (M=3.51, SD=1.05) is also relatively *high* that further shows how their parents ignite their determination to succeed.

Likewise, teachers have a vital role in meeting students' needs, which contributes to their desire for learning and accomplishing task (Niemiec & Ryan, 2009). In addition, the degree in which students feel independent towards their learnings influences their drive to accomplishing a task (Gagne & Deci, 2005).

Levels of Students' Intrinsic Motivation

The Intrinsic Motivation of the students were measured using a 7-point Likert scale questionnaire adopted from Mcauley, Dunca, and Tammen (1987). High intrinsic motivation in mathematics is associated with high responses on the questionnaire's item indicators.

Table 4 shows the level of Intrinsic Motivation (M=4.16, SD=0.87) of the students where they manifested a moderate level. Intrinsic Motivation has subdomains namely Interest/Enjoyment, Perceived Competence, Perceived Choice, and Pressure/Tension. These subdomains are main factors that affect the overall result of Intrinsic Motivation.

As revealed in the results, when students are immersed in activities that are engaging, students will seemingly display a moderately high level of interest towards accomplishing a task manisfested in Interest/Enjoyment (M=4.85, SD=1.1). They found out that mathematics tasks are intriguing, entertaining, and delightful to accomplish.

Additionally, the students' Perceived Competence (M=3.63, SD=1.37) is of Moderate level. Students believed that they are skilled at doing task in mathematics. On the other hand, students become less selective on how they choose to do task in mathematics, and this is indicative on their

moderate level of Perceived Choice (M=4.26, SD=0.98). Furthermore, the Pressure/Tension (M=3.64, SD=0.98) is in moderate level. Thus, it was an implication that students feel a little nervous, pressured, anxious towards solving math problems.

When student's intrinsic motivation is high, their willingness in fulfilling a task is always evident in their performances. Furthermore, students who are intrinsically motivated to learn mathematics are determined by their own desire to acquire and grasp knowledge and understanding of mathematical concepts. Along with this, students engage to complete a task because it gives them a sense of accomplishment and satisfaction, and they viewed learning as having an impact on their self-images. Consequently, intrinsically motivated students, concentrates on understanding concepts (Mueller, et al., 2011). This is a challenging factor which can greatly affect self-determination, self-efficacy, and how students contextualize mathematics. Moreover, student's intrinsic motivation could still be improved when the teacher will enhance math activities to be engaging and fun inside the classroom (Cordova & Lepper, 1996).

Table 4. Descriptive levels of students' intrinsic motivation (n=214)

	M	SD	QD
Interest/Enjoyment	4.85	1.1	MH
1.While I was working with activities in mathematics, I was thinking about how much I enjoyed it.	4.82	1.59	MH
2. I found the activities in mathematics very interesting.	5.14	1.49	MH
3. Doing the activities in mathematics was fun.	5	1.54	MH
4. I enjoyed doing the activities in mathematics very much.	4.68	1.54	MH
*5. I thought the activities in mathematics were very boring.	4.55	1.78	MH
6. I thought the activities in mathematics were very interesting.	4.97	1.43	MH
7. I would describe the activities in mathematics as very enjoyable.	4.8	1.49	MH
Perceived Competence	3.63	1.37	M
8. I think I am pretty good at activities in mathematics.	3.72	1.53	M
9. I think I did pretty well at activities in mathematics compared to other students.	3.07	1.55	ML
10. I am satisfied with my performance in mathematics activities.	4.09	1.75	M
11. I felt pretty skilled at activities in mathematics.	3.56	1.55	ML
12. After working at activities in mathematics for a while, I felt pretty competent.	3.72	1.61	M
Perceived Choice	4.26	0.98	M
13. I felt that it was my choice to do activities in mathematics.	4.27	1.63	M
*14. I did not really have a choice about doing the activities in mathematics	4.19	1.73	M
15.I felt like I was doing what I wanted to do while I was working on activities in mathematics.	4.15	1.6	M
16.I felt like I had to do the activities in mathematics.	4.65	1.49	MH
*17. I did the activities in mathematics because I had no choice.	4.04	2.08	M
Pressure / Tension	3.64	0.98	M
18. I did not feel nervous about doing the activities in mathematics.	3.44	1.73	ML
*19. I felt tense while doing the activities in mathematics.	3.57	1.67	ML
20.I felt relaxed while doing the activities in mathematics.	3.29	1.64	ML
*21. I was anxious while doing the activities in mathematics.	4.13	1.55	M
*22. I felt pressured while doing the activities in mathematics.	3.78	1.75	M
Overall	4.16	0.87	M

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.85 = Very Low (VL), 1.86 – 2.71 = Low (L), 2.72 – 3.57 = Moderately Low (ML), 3.58 – 4.43 = Moderate (M), 4.44 – 5.29 = Moderately High (MH), 5.30 – 6.15 = High (H), 6.16 – 7.00 = Very High (VH).

Level of Self-efficacy

The Self-efficacy of the students were measured using 5-point Likert scale questionnaire adopted from the study of Graumer et al. (2018). High students' self-efficacy is interrelated with high responses on the questionnaires' item indicators. The five-sectional Likert scale measured the level of students' personal judgement of capabilities to accomplish mathematics tasks or known as students' self-efficacy.

Table 5 revealed how the students persevere to accomplish their task in mathematics despite the complexity of the problem and theu also gained relatively *high* level towards Self-efficacy (M=3.72, SD=0.61). This revealed that students can learn how to comprehend an abstract concept in mathematics if they only have the confidence and willingness to study harder. Additionally, students' learning towards mathematics could be enriched whenever they focus on their progress and not merely believing they cannot solve any math problem. Consequently, the results displayed that students' has a *moderate* level of self-efficacy (M=3.30, SD=0.87) in which they can acquire learning of mathematical concepts within the whole school year. It was also showed that students have a *moderate* level of self-efficacy (M=3.34, SD=0.97) in which students displayed the ability to succeed in any mathematics course they take.

Results have also shown that the students are determined to complete a given task if they are confident enough to fulfil it and motivated to absorb the concepts compared to their peers with low level of self-efficacy (Zeldin & Pajares et al., 2008). Furthermore, it is a student's belief that adopting particular habits would lead to success in the mathematics class and activities (Causapin, 2012).

Table 5. Descriptive levels of students' self-efficacy (n=214)

	M	SD	QD
1. I can learn what is being in Math subject this year.	3.3	0.87	M
2. I can figure out anything related in Math subject if I try hard enough.	3.7	0.83	H
3. If I practiced solving every day, I could develop mathematical skill.	3.99	0.93	H
4. Once I've decided to accomplish a mathematics task that's important to me, I keep trying to accomplish it, even if it is harder than I thought.	3.81	0.89	H
5. I am confident that I will achieve the goals that I set for myself in the math subject.	3.5	0.93	H
6. When I'm struggling to accomplish a difficult mathematics task, I focus on my progress instead of feeling discouraged.	3.77	0.91	H
7. I will succeed in whatever mathematics task I choose.	3.43	0.94	H
8. I will succeed in whatever mathematics courses.	3.34	0.97	M
9. I believe my hard work in mathematics subject pays off.	3.66	0.92	H
10. My ability in mathematics grows with effort.	3.79	0.86	H
11. I believe that the brain can be developed like a muscle.	4.08	0.85	H
12. I think that no matter who you are, you can significantly change your level of talent.	4.1	0.86	H
13. I can change my basic level of ability considerably.	3.89	0.84	H
Overall	3.72	0.61	H

Note: M = mean, SD = Standard deviation, QD = Qualitative description: 1.00 – 1.79 = Very Low (VL), 1.80 – 2.59 = Low (L), 2.60 – 3.39 = Moderate (M), 3.40 – 4.19 = High (H), 4.20 – 5.00 = Very High (VH)

Evaluation of Measurement and Structural Models

Measurement Models of Motivation to contextualize Mathematics, Self-determination, Intrinsic Motivation, and Self-efficacy depicts the relationships between the construct under investigation. Additionally, it presents an evaluation of the relationships between the item-indicators and their corresponding construct (Hair et al., 2014; Hair et al., 2016). This section reports the reflective indicators in PLS-SEM that are based on convergent validity of the measures associated with the individual constructs, discriminant validity, variance inflation factor (VIF) and reliabilities (Hulland, 1999; Kock and Lynn, 2012).

Table 6 presents the convergent validity that measures the quality of the constructs (which is typically a set of question-statement or items). The items associated with each construct in a measurement instrument have excellent convergent validity if the respondents understand them in the same way that the item designer intended them to be interpreted (Kock, 2017). The convergent validity is essential in assessing the quality of the item loadings to prevent redundancy among the items gathered from the respondents. Hence, it ensures the reliability among the measures of the construct. Indicator loadings determines the correlation between items and construct and it must be equal to or greater than 0.5 in order for the construct to be statistically significant (Kock, 2015).

In addition, the Average Variance Extracted (AVE) evaluates the construct convergent validity and further determines the variance and the errors in each construct. The Average Variance Extracted (AVE) must be at least 0.5 order for the construct to be acceptable (Fornell & Larcker, 1981). As reflected in Table 6, out from the four constructs, only the Intrinsic Motivation (AVE=0.51) is considered to be within the range of acceptable validity and the rest of the construct failed. However, when the composite reliability is equal to or greater than 0.7, the contruct is still deemed to be adequate (Fornell & Larcker, 1981).

Moreover, the Variance Inflation Factor (VIF) presents that there is no existing multicollinearity among the item indicators to guarantee the significance of the constructs in which the value of each item indicator in terms of the VIF must be equal to or lesser than 3.3 to ensure that there is no multicollinearity existed (Kock, 2017). As reflected in the results in Table 6 that majority of the item loadings have passed the threshold of reliability measures. However, some of the item loadings have been removed (CM=6, IM=10, SD=5) except SE for all item loadings of this latent construct have passed the standard measure to ensure that there is no multicollinearity existed among the item indicators. Furthermore, reliability should be tested among the construct in order for it to be acceptable. Reliability is measured with two renowned types of reliability test (Composite Reliability and Cronbach's Alpha) to reveal a concrete construct. A high reliability corresponds to strong construct. Hence, to reflect a reliability the value of the Cronbach's Alpha and Composite Reliability must be equal to or higher than 0.7 (Nunnally & Berntein, 1994). As shown in Table 6 that the values of the construct are relatively high in *Motivation to contextualize Mathematics* (CR=0.94, CA=0.93), *Self-determination* (CR=0.94, CA=0.93), *Intrinsic Motivation* (CR=0.92, CA=0.91), and *Self-efficacy* (CR=0.92, CA=0.91). These reflect that the constructs have passed the reliability test.

The discriminant validity is to be tested to ensure that the instruments are not highly correlated with each other to prevent confusion among the respondents in answering the questionnaire. Moreover, in order to establish the discriminant validity among the statement of the instruments there is a need to determine the square root of the AVE coefficients that it must be greater than any correlations within the particular variable (Fornell & Larcker, 1981). As presented in table 7, the square roots of the AVEs in the Motivation to contextualize Mathematics (0.69), Intrinsic Motivation (0.71), Self-determination (0.68), and Self-efficacy (0.69) are way higher than the involved correlations towards other variables.

Apparently, all the AVE coefficients of the constructs have no issue about vertical and horizontal correlation and each construct has a stronger discriminant coefficient implying that it has passed the discriminant validity test. Hence, the constructs are valid to proceed to the next phase of measurement.

PLS Model of the Study

This study aims to determine that the model has a better fit as it used PLS-SEM in measuring the quality of the model. Thus, it is important to identify several indices involved namely average path

coefficient (APC), average R^2-squared (ARS), average adjusted R^2-squared (AARS), averaged block variance inflation factor (AVIF), average full collinearity VIF (AFVIF) and Tenenhaus goodness of fit (GoF). Moreover, the p-values of APC, ARCS and AARS must be equal to or lower than 0.05 (Kock, 2017) in order for the model to be acceptable.

As shown in Table 8, the values of APC (0.274, p<0.001), ARS (0.335, p<0.001) and AARS (0.326, p<0.001) are within the acceptable range. Additionally, AVIF and AFVIF must have the value equal to or lower than 3.3 for it to satisfy the threshold of the goodness of fit. Furthermore, the Tenenhaus GoF is an explanatory power of the model and must have the following threshold: small if equal to or more than 0.1, medium if equal to or greater than 0.25 and large if equal to or greater than 0.36 (Wetzels et al, 2009; Kock, 2017). As seen from the indices, the model is within the threshold of the better fit indicating that the theoretical model of this study is parallell and fit with respect to the empirical data gather from the respondents.

Figure 3 and Table 9 present the PLS path model and the corresponding path coefficients. The results revealed the significant interrelationship among Motivation to contextualize Mathematics, Self-determination, Intrinsic Motivation, and Self-efficacy. As reflected in the results, among the direct effects, the Motivation to contextualize Mathematics significantly and positively affects Self-efficacy (β=0.253, p<0.001) this implies that when the motivation of students to contextualizing mathematics increases, their Self-efficacy also increases. This shows that when students are immersed in utilizing contextualization in solving math problems and have the tendency to relate math problems to real world scenarios that involved prior experiences they encountered from their environment will aid their personal judgement to accomplish a task despite of its complexity. It has been asserted that contextualization can also accumulate students' Self-efficacy (Bandura, 1997; Weitlauf et al., 2001). It was evident from the results that students could have higher confidence in fulfilling a task if they are given a chance to contextualize math problems.

Table 6. Indicator loadings, AVE, reliability measures

Construct/Item	Indicator loading	VIF	AVE	CR	CA
Motivation to Contextualize Mathematics			***0.48***	***0.94***	***0.93***
CM1	0.548	1.624			
CM2	0.736	2.519			
CM3	0.691	2.254			
CM4	0.591	1.658			
CM5	0.744	2.806			
CM7	0.599	1.963			
CM8	0.676	2.486			
CM9	0.618	1.923			
CM10	0.790	2.837			
CM11	0.781	2.574			
CM12	0.619	1.977			
CM13	0.728	2.400			
CM14	0.748	2.800			
CM15	0.743	2.571			
CM16	0.729	2.561			
CM17	0.742	2.566			
CM18	0.735	2.294			
CM22	0.508	1.442			
Intrinsic Motivation			***0.51***	***0.92***	***0.91***
IM1	0.755	2.72			
IM2	0.745	2.81			
IM3	0.710	2.31			
IM6	0.532	1.40			
IM9	0.751	2.17			
IM10	0.756	2.09			
IM12	0.795	2.51			
IM13	0.749	2.36			
IM15	0.762	2.34			
IM16	0.563	1.52			
IM18	0.655	1.80			
IM20	0.712	2.05			
Self-Determination			***0.46***	***0.94***	***0.93***
SD1	0.586	1.64			
SD2	0.742	2.49			
SD3	0.729	2.52			
SD4	0.732	2.41			
SD5	0.704	1.87			
SD6	0.664	2.03			
SD7	0.754	2.59			
SD8	0.729	2.52			
SD9	0.769	2.88			
SD10	0.673	1.90			
SD11	0.774	2.51			
SD12	0.716	2.21			
SD13	0.582	2.23			

Construct/Item	Indicator loading	VIF	AVE	CR	CA
SD14	0.531	2.31			
SD15	0.599	1.77			
SD18	0.551	2.72			
SD19	0.646	2.16			
SD21	0.683	2.19			
Self-Efficacy			*0.47*	*0.92*	*0.91*
SE1	0.589	1.58			
SE2	0.623	1.65			
SE3	0.678	1.91			
SE4	0.707	2.03			
SE5	0.771	2.78			
SE6	0.700	1.80			
SE7	0.770	3.16			
SE8	0.748	3.05			
SE9	0.728	2.14			
SE10	0.719	1.90			
SE11	0.651	2.00			
SE12	0.604	2.10			
SE13	0.628	2.06			

Notes: All item indicators are significant at 0.001 ($p < 0.001$). AVE = average variance extracted; VIF = variance inflation factor; CR = composite reliability; CA = Cronbach's alpha

Table 7. Square roots of AVE coefficients and correlation coefficients

	CM	IM	SD	SE
CM	***0.69***			
IM	0.23	***0.71***		
SD	0.47	0.38	***0.68***	
SE	0.46	0.61	0.50	***0.69***

Notes: Diagonal elements are the square root of AVE of constructs, while the off-diagonal elements are the correlation between constructs. CM = Motivation to Contextualized Mathematics, IM = Intrinsic Motivation, SD = Self – determination, and SE = Self – efficacy.

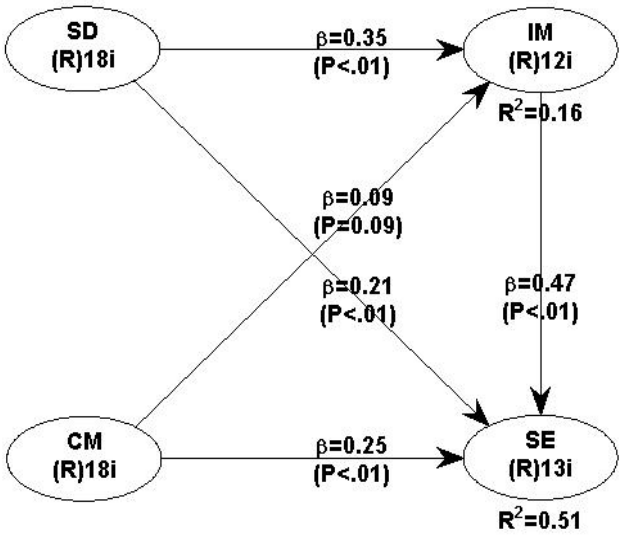

Figure 3. The PLS path model with path coefficients

Table 8. Model fit and quality indices

Index	Coefficient
APC	0.274, P<0.001
ARS	0.334, P<0.001
AARS	0.326, P<0.001
AVIF	1.304, acceptable if <= 5, ideally <= 3.3
AFVIF	1.639, acceptable if <= 5, ideally <= 3.3

Tenenhaus GoF	0.400, small >= 0.1, medium >= 0.25, large >= 0.36

Note: APC = average path coefficient,ARS = average R-squared, AARS = average adjusted R-squared, AVIF = average block variance inflation factor, AFVIF = average full collinearity VIF, and Tenenhaus goodness of fit (GoF)

Table 9. Direct and indirect effects of the PLS path model

				β	SE	P-value	f^2
Direct Effects							
H1	CM⟶	IM		0.090	0.067	0.090	0.022
H2	CM⟶	SE		0.253	0.065	<.001	0.118
H3	SD⟶	IM		0.351	0.064	<.001	0.137
H4	SD⟶	SE		0.205	0.066	0.001	0.105
H5	IM⟶	SE		0.470	0.063	<.001	0.284
Indirect Effects							
H6	CM⟶	IM⟶	SE	0.130	0.047	0.003	0.061
H7	SD⟶	IM⟶	SE	0.188	0.047	<.001	0.096

Notes: f^2 is the Cohen's (1988) effect size: 0.02 = small, 0.15 = medium, 0.35 = large; SE = standard error; β = standardized path coefficient

However, the students' motivation to contextualize mathematics did not significantly affect Intrinsic Motivation (β=0.090, p=0.090).

Self-determination significantly and positively affects Intrinsic Motivation (β=0.351, p<0.001) and Self-efficacy (β=0.205, p=0.001). However, in terms of Self-determination to Intrinsic Motivation suggests that when there is a one point increase in Self-determination, the standarn deviation of Intrinsic Motivation will also exceed to 0.351 which is way higher compared to the standard deviation of Self-determination towards self-efficacy. This implies that Self-determination can greatly affect student's Intrinsic Motivation in which if students were firm in their beliefs to set goals to be fulfilled then their feeling to work out task alone without external rewards tends to increase. Moreover, Self-determination fostered intrinsic motivation of the students when they are set in a contextualized event (Deci & Ryan, 2000; Banfield & Wilkerson, 2014). Though, self-determination to self-efficacy has standard deviation of 0.205 still it can manifest effects to self-efficacy. It marked that when students manifested awareness towards their capabilities and determined to engage in achieving their goals then it happens that their self-efficacy could also be improved (Mc Gregor et al., 2006).

Evidently, among the direct effects of the constructs, only the Intrinsic Motivation to Self-efficacy obtained a higher standard deviation of 0.470 and has medium effect size (f^2=0.284). This implies that Intrinsic Motivation significantly and positively affects Self-efficacy in a greater extent. This means when students carry out tasks involving math problems and solving it with interest/enjoyment and choice to do it then their self-efficacy will significantly increase that they would tend to survive and pass their course despite how difficult that would be. This is supported that when students possess high Intrinsic Motivation, they can gained deeper understanding in completing a task (Chentanez et al., 2004).

As the main focus of the analysis, the mediating effect of Intrinsic Motivation was tested towards the relationships both of the motivation to contextualize Mathematics and Self-determination towards self-efficacy. Results of these are presented in Table 9 through the indirect effects. Results revealed that the intrinsic motivation significantly mediates the relationship between students' motivation to contextualize Mathematics and Self-efficacy ($\beta = 0.130, p < 0.003$). It manifested

that when the Intrinsic Motivation increases, the relationship of Motivation to contextualize Mathematics and Self-efficacy increases as well, with a small effect size ($f^2 = 0.061$). This reveals that when students render competence, interest/enjoyment, choices or willingness to complete a task, and feel tension/pressure along the process of learning, they will likely overcome challenges and tough problems especially when they are assigned to solve a complex math problem.

Futhermore, contextualization can be a foundation to strengthen self-efficacy (Bandura, 1997; Weitlauf et.al, 2001). However, there are researchers studying about Intrinsic Motivation as a mediating variable between two constructs but there are few studies about the mediating effects of Intrinsic Motivation between these constructs. Hence, Intrinsic Motivation should be augmented in order for the Motivation to contextualize Mathematics to Self-efficacy increases as well as the Self-determination to Self-efficacy.

Moreover, Intrinsic Motivation significantly mediates the relationship between Self-determination and Self-efficacy ($\beta = 0.188, p < 0.001$) with a small effect size ($f^2 = 0.096$), this is considerably higher than the effect size of the Intrinsic Motivation that mediates between Motivation to contextualize Mathematics and Self-efficacy. Apparently, there is a stronger mediating effects of Intrinsic Motivation between Self-determination and Self-efficacy. This means that self-determination can increase self-efficacy through Intrinsic Motivation likewise when the mediating variable increases the two constructs increase as well. This is supported that self-determination promotes Intrinsic Motivation of the students. Moreover, Intrinsic Motivation increases self-efficacy. Similarly, Self-efficacy was found to be highly correlated with Intrinsic Motivation (Banfield & Wilkerson, 2014; Gafoor & Kurukkan, 2015). This further implies that when students are intrinsically motivated then they will be able to engage in more complicated math problems.

FINDINGS

It was found out from this study that:

1. The Motivation to Contextualize Mathematics does not affect Intrinsic Motivation in which the results revealed that there is no significant relationship between Motivation to contextualize Mathematics and Intrinsic Motivation ($\beta = 0.090, p < 0.090$) which shows that there is no direct effect from Motivation to contextualize Mathematics to Intrinsic Motivation.
2. The Motivation to contextualize Mathematics positively affects Self-determination of the students in which the results display that there is a significant relationship between Motivation to contextualize Mathematics and Self-efficacy ($\beta = 0.253, p < 0.001$) which implies that when the Motivation of the students to contextualizing Mathematics increases, the Self-efficacy increases as well.
3. The Self-determination positively affects Intrinsic Motivation of the students in which results revealed that there is a significant relationship between Self-determination and Intrinsic Motivation ($\beta = 0.351, p < 0.001$) which further elucidates that if students' Self-determination increases so does Intrinsic Motivation.
4. The Self-determination positively affects Self-efficacy ($\beta = 0.205, p < 0.001$). If the level of students' self-determination rises so does self-efficacy.
5. The Intrinsic Motivation positively affects Self-efficacy in which it was revealed in the results that there is a strong direct relationship between Intrinsic Motivation and Self-efficacy $\beta = 0.470, p < 0.001$).
6. Intrinsic Motivation significantly mediates the relationship between Motivation to contextualize Mathematics and Self-efficacy ($\beta = 0.130, p < 0.001$) when Intrinsic Motivation increases, the relationship between Motivation to contextualize Mathematics and Self-efficacy will also increase.

7. Intrinsic Motivation significantly mediates the relationship between Self-determination and Self-efficacy $\beta = 0.188, p < 0.001$) when Intrinsic Motivation of the students increases, the relationship between Self-determination and Self-efficacy will also increase.

CONCLUSIONS

The Motivation to contextualize Mathematics of the undergraduate students of School of Teacher Education (STE) and School of Engineering and Technology (SET) who undergone Math-related courses is at high level. The respondents confirmed that contextualizing mathematics is an effective strategy that they used and could improve their self-efficacy in facing Math-related activities. It also suggests that by the use of this strategy the students can increase their comprehension skills and accomplishments through gaining better understanding of abstract math concepts (Valenzuela, 2018). Teachers innovating classroom activities that fosters contextualization in the part of the development of the lessons greatly contributes to this effect. Furthermore, students who employ this strategy will tend to have better understanding in distinguishing and comparing the relationships of abstract concepts.

The self-determination directly affects the intrinsic motivation and self-efficacy of the students indicating that when students are goal-directed, self-regulated, and prossess autonomous behavior towards accomplishing math activities or tasks assigned to them they will exhibit an inclination to develop motivation within themselves that they can overcome most complicated problems (Banfield & Wilkerson, 2014). This implies that students manifested confidence in making decisions and plans and have the capability in predicting things causing them to gain belief and motivation towards themselves.

Intrinsic Motivation is the most essential construct in this study wherein it mediates between the motivation to contextualize mathematics and self-efficacy likewise it also mediates between self-determination and self-efficacy providing evidences that intrinsic motivation is advisable to be improved among the students in order that the rest of the constructs may also be improved. These implications suggest that teacher must exert innovative, resourceful, and extra efforts towards constructing interventions to further encourage students to be intrinsically motivated in learning mathematics and to have proficient mathematics performance. Students who possessed intrinsic motivation within themselves display the tendency to create an avenue of confidence in improving their learnings for they were not just focusing on grades alone but by how much they learn.

However, among the constructs only the Motivation to contextualize Mathematics and Intrinsic Motivation have no direct relationship in this study even it had a direct relationship in other studies. This further implies that the constructs could not be true to all locality.

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