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Self-Efficacy and Mathematics Learning Experience Using 5Es Model among Pre-service Teachers

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Abstract

This study employs a descriptive- correlational design, using both qualitative and quantitative approaches, to investigate the self- efficacy levels of pre- service mathematics teachers in relation to their exposure to the 5Es instructional phases. Data was gathered from 106 pre- service mathematics teachers at Batangas State University Campuses during the academic year 2020-2021 using a researcher-made questionnaire and focus group discussions. Mean, Standard deviation, Pearson r, and Thematic Analysis were used to analyze the data. The results reveal a strong correlation between pre- service teachers' self- efficacy in mathematics and their exposure to the 5Es instructional phases. Additionally, it suggests the potential effectiveness of a researcher-made mathematics learning guide in enhancing students' self- efficacy in mathematics. This research underscores the importance of diverse learning strategies for mastering mathematical concepts, encourages instructors to innovate and adapt their instructional practices based on the 5Es model to enhance students' self- efficacy in mathematics, and calls for future research to explore additional factors that influence students' self-efficacy when exposed to 5Es instructional phases.

Keywords: Self-efficacy, Mathematics, Learning experience, Higher education

Introduction

The primary objective of 21st-century education was to prepare students to meet the demands of the contemporary world. Rapid and diverse advancements in science and technology had elevated urban living standards and increased expectations for the modern educational system. This necessitated the replacement of conventional teaching methods and outdated curricula in educational institutions, leading to improvements in instructional models and curricula through research explorations and empirical studies.

Alongside these curriculum shifts, there was a transition in instructional methodologies from teacher-centered learning to learner-centered erudition. In the former, the teacher played an active role in curriculum transmission, whereas the latter involved active learner participation in the learning process.

The introduction of a constructivist approach to education encouraged critical thinking skills and elevated engagement at multiple levels. Learning in this framework actively involved the development and construction of new ideas (Hussain, 2012). Additionally, the constructivist philosophy could be incorporated into the curriculum (O'shea & Leavy, 2013), allowing teachers to create conducive learning environments for students to construct their own understandings.

Teaching and understanding mathematics remained a significant challenge (Beswick, 2012). To address this complexity, teachers devised effective instructional methods and materials. However, the COVID-19 pandemic revealed the need for additional motivation to ensure a strong mathematical foundation and prevent difficulties at higher levels (Rahiem, 2021). Mathematics instructors aimed to motivate students through engagement and supervision, employing various instructional models, including the 5Es learning cycle, based on experiential learning theories (Kolb & Kolb, 2012).

Bybee (2015) outlined the five stages of the 5Es model: Engagement, Exploration, Explanation, Elaboration, and Evaluation. Notably, self-efficacy and mathematics anxiety significantly impacted students' college mathematics grades (Czocher et al., 2020). Thus, educators sought to enhance students' mathematical self-efficacy and reduce mathematics anxiety, factors critical to their persistence and success in advanced disciplines (Griggs et al., 2013). Student motivation, as influenced by self-efficacy and teacher support, played a key role (Skaalvik et al., 2015).

As college mathematics instructors responded to the need to promote mathematics literacy, the value of students' mathematics self-efficacy gained increased attention (Mesa, 2012). Higher self-efficacy was associated with increased motivation and perseverance in tackling challenging tasks. The four primary sources of self-efficacy—mastery experience, vicarious experiences, social persuasion, and physiological states (Bandura, 1997)—became key elements.

In the context of learning mathematics, students' self-confidence played a crucial role. Determining and comprehending students' self-efficacy is vital for encouraging academic performance, perseverance and motivation, improving psychological health, creating successful educational interventions, and cultivating a lifelong learning mentality. Meanwhile, the 5Es instructional model combined various methods to provide a unique mathematics learning experience, aiding students in developing a strong knowledge foundation through active participation. The increased exposure to the 5Es model was seen as a means for teachers to innovate their instructional delivery, while simultaneously enhancing students' self-efficacy and boosting academic engagement and performance.

Theoretical Framework

The current study is anchored on the foundational principles of self-efficacy theory found between the locus of control (Rotter, 2011) and social cognitive theory by Albert Bandura. The idea that humans, themselves, control over actions that affect their lives are the common elements of these theories (Zee & Koomen, 2016; Bandura, 1977). Rotter theorized locus of control as a set of expectations that each individual develops through interaction and experiences with their environment in the form of reinforcements. Rotter then categorized locus of control into two, external and internal. When people perceived whether outcomes were result of luck, fate or kindness of other people, it is categorized as external. On the other hand, when people perceived those outcomes were result of their own actions such as hard work, dedication and discipline, it is categorized as internal. Hence, those who adopted an external locus of control considered themselves as a beneficiary of a friendly environment.

In contrast, in internal locus of control, a person credits good grade or promotion with competence, hard work, and perseverance. Credit poor grades and missed promotions and opportunities when there is lack of preparation or failing to meet expectations. According to Rotter, an individual becomes happier, more self-motivated, tend to easily adapt to changes, overcome obstacles easily, and become more successful when successes and failures are being attributed into their own actions (Rotter, 2011).

Building on Rotter's theory, Albert Bandura on the other hand argued that people are not only motivated by general expectancies. Bandura claimed that people were also influenced by what they perceived as their capabilities and made a clear distinction between response-outcome expectancies and self-efficacy expectations. Bandura defined response-outcome expectations as individuals' estimates wherein a given behavior leads to certain outcomes (Bandura, 1977).

With self-efficacy theory, Bandura (1977) argues that an individual may know that a given action or behavior may lead to positive result. Hence, the primary cause of human behavior is personal self-efficacy.

People with higher level of self-efficacy set challenging goals and maintains strong commitment to them. In the face of inhibiting failure, they persevere, increase and sustain efforts in order to become successful. Threatening situations are being faced with confidence so as they can have control over them. According to Bandura (1977), this type of outlook in life helps to reduce and lower stress and depression, respectively.

Objectives

The study aimed to determine the manifestation of self-efficacy and its relationship to mathematics learning experience using 5Es model of the mathematics pre-service teachers in BatStateU Campuses under the program Bachelor of Secondary Education major in Mathematics during the academic year 2020-2021.

Specifically, it aimed to:

1. Determine the level of manifestation of self-efficacy of mathematics pre-service teachers in terms of:

1.1 mastery experience;

1.2 vicarious experience;

1.3 verbal persuasion;

1.4 somatic and emotional state.

2. Assess mathematics learning experience in terms of the respondent's degree of exposure following 5Es instructional phases:

2.1 engage;

2.2 explore;
2.3 explain;
2.4 elaborate;
2.5 evaluate.

3. Correlate the respondents' assessments on level of manifestation of self-efficacy and the degree of exposure to 5Es instructional phases.

4. Identify the pre-service teachers' discourses on self-efficacy through exposure on 5Es.

5. Propose a mathematics learning guide.

Methodology

Research Design

The researcher utilized descriptive-correlational design in the study. According to Stangor & Walinga (2014), the purpose of this design is to describe and measure relationship between or among relevant variables. In this method, the researcher does not seek to control or change the variables in this design, as in an experiment; instead, they relate using correlation statistics.

Respondents

This study considered three campuses in Batangas State University offering Bachelor of Secondary Education major in Mathematics. There were a total 145 mathematics pre-service teachers. The researcher used the Raosoft calculator, at 5 percent margin of error, to identify the sample size of 106. The number of respondents per campus was selected using stratified random sampling with proportionate allocation. Pre-service teachers were chosen as respondents since they were considered to be the most credible representative for this group. It is assumed that pre-service teachers are well-equipped with the knowledge and skills of mathematics learning experience using 5E's model as they manifest mathematics self-efficacy which can help their future students to develop positive attitude towards mathematics.

Data Gathering Tool

The major data collection instrument for this study was a researcher-made questionnaire separated into three components. The first section of the test assessed respondents' level of manifestation of self-efficacy in terms of mastery experience, vicarious experience, verbal persuasion and somatic and emotional states with a total of 46 indicators. The second part of the survey determined the respondents' degree of exposure to 5E's instructional phases as to engage, explore, explain, elaborate and evaluate comprising a total of 54 items. Additionally, the third part is composed of four guide questions utilized in the focus group discussion to identify the discourses on self-efficacy through exposure on 5E's. The item statements and guide questions are based on the pre-survey questionnaire made by the researcher.

Cronbach alpha coefficient was computed to assess the internal consistency of the item statements along pre-service teachers' manifestation level of self-efficacy as exposed to 5E's instructional phases. The computed values of 0.940 for respondents' level of manifestation of self-efficacy and 0.987 for their assessment on the degree for their exposure to 5E's instructional phases are greater than 0.70 affirming the questionnaire as sufficiently reliable.

The responses in the questionnaire were given in a fixed alternative format. A four-point rating scale was used as options for the responses. The following scale continuum and corresponding VIs are given as follows:

Numerical Value	Mean Ranges	Interpretation
4	3.50 - 4.00	Highly Manifested / Highly Exposed
3	2.50 - 3.49	Manifested / Exposed
2	1.50 - 2.49	Slightly Manifested / Slightly Exposed
1	1.00 - 1.49	Least Manifested / Least Exposed

Data Collection Procedure and Treatment

The final version of the questionnaire was administered to the target respondents once its validity and reliability were established. The researcher sought the approval of the higher authorities for the administration of the questionnaire. Test questionnaire distribution was done in online mode since this study was conducted during challenging time caused by a pandemic. Focus group discussion was also done in online mode through google meet.

Upon the development of the questionnaire, it was replicated to collect necessary data. Through a letter of request, the researcher obtained approval from Vice Chancellor for Academic Affairs of Batangas State University campuses and deans of College of Teacher Education. After getting the approval, the researcher distributed the questionnaire to the respondents who agreed to participate in the study to understand its substance and aim.

Google Forms and Google Meet were used to administer the questionnaire and conduct focus group discussion. The data obtained from the questionnaire replies were tallied, tabulated, processed, evaluated, and provided anonymously as grouped data by the researcher in accordance with the country's data privacy laws.

The gathered qualitative data were analyzed using weighted mean and standard deviation and Pearson Product Moment Correlation. Whereas, through a comprehensive analysis of the qualitative data, the researchers were able to empower students pursuing teacher education, encouraging them to consider and employ diverse learning strategies for mastering mathematical concepts. This approach aimed to enhance their self-efficacy in mathematics.

Results

The collected data were analyzed to create and demonstrate the tables below. These are intended to point out and clarify the findings in accordance with the study's objectives. They provide the findings in an organized and easily comprehensible manner.

1. Level of Manifestation of Self-efficacy

1.1. Mastery Experience

Table 1 Level of Manifestation of Self-Efficacy in Terms of Mastery Experience

Table 1 shows the pre-service teachers' level of manifestation of self-efficacy in terms of mastery experience. Also, it displays how the pre-service teachers share knowledge during discussions in mathematics classes, concentrate on complex mathematical problems until finding the correct answer and figure out mathematical problems like dividing up a restaurant bill when hanging out with friends.

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Understanding mathematical concepts easily	3.10	0.58	Manifested
2. Sharing knowledge during discussions in mathematics classes	3.22	0.68	Manifested
3. Solving mathematical problems before other do	2.99	0.65	Manifested
4. Helping classmates with complex mathematics problems	3.17	0.67	Manifested
5. Concentrating on complex mathematical problems until finding the correct answer	3.22	0.65	Manifested
6. Identifying the given problem and easily solves the problem	3.06	0.71	Manifested
7. Receiving good grades in mathematics courses	3.06	0.70	Manifested
8. Passing mathematics examinations with exemplary scores	2.91	0.71	Manifested
9. Demonstrating ability to think and work abstractly and see mathematical patterns and relationships	3.05	0.64	Manifested
10. Figuring out mathematical problems like dividing up a restaurant bill when hanging out with friends	3.20	0.70	Manifested
11. Identifying proper heuristics to be used in solving mathematical problems	3.02	0.68	Manifested
12. Accomplishing given mathematical tasks easily	3.02	0.65	Manifested
Overall	**3.08**	**0.50**	**Manifested**

It implies that the students boost their mastery with collaborative learning and able to understand difficult problems. This is supported in the study of Bernacki et al. (2020), studying through collaboration shows benefits specifically memory increase and utilization of knowledge in real-life scenario. In addition, educators, academicians, and policymakers all understand the value of small-group collaboration in promoting student learning.

1.2 Vicarious Experience

Table 2 reveals the respondents' level of manifestation of self-efficacy in terms of vicarious experience. As observed, pre-service teachers have strong levels of self-efficacy when watching video recorded lectures to grasp mathematical ideas, observing a teacher answer a problem quickly, and seeing other students perform well in mathematics.

This implies that students are able to understand mathematical concepts while observing how others perform. This supports the idea of Hoover et al. (2012), that the benefits of vicarious observational learning over direct experience sequencing appeared to be quite consistent. Observational learning is a good way to acquire and improve particular skills and strengths.

Table 2 Level of Manifestation of Self-Efficacy in Terms of Vicarious Experience

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Noticing other students sharing their knowledge and idea on a certain topic motivates to do the same.	3.47	0.60	Manifested
2. Seeing other students perform well in mathematics gives motivation to do better as well.	3.53	0.59	Highly Manifested
3. Watching other students listen attentively to the teacher gives encouragement to focus more on the discussion.	3.48	0.64	Manifested
4. Perceiving some classmates participate in mathematics activities gives encouragement to be active in class.	3.38	0.68	Manifested
5. Having some friends working on tough mathematics problems boosts confidence to solve the same problems.	3.52	0.64	Highly Manifested
6. Looking at the teacher solve a problem easily is inspiring to learn the lesson well.	3.56	0.65	Highly Manifested
7. Seeing other students doing an advance study is an influence to do the same.	3.29	0.70	Manifested
8. Observing friends' success in mathematics increases the belief to learn the lesson well.	3.45	0.65	Manifested
9. Noticing how other students solve mathematics problems is an influence to try solving the same problem.	3.40	0.63	Manifested
10. Seeing other students volunteer in doing mathematics activities is encouraging.	3.29	0.77	Manifested
11. Watching video recorded lectures to understand mathematical concepts.	3.58	0.55	Highly Manifested
Overall	**3.45**	**0.48**	**Manifested**

1.3 Verbal Persuasion

Receiving positive verbal feedback while performing a difficult task convince a person that they have the necessary skills and ability to succeed. Shown in Table 3 is the pre-service teachers' level of manifestation of self-efficacy in terms of verbal persuasion.

Table 3 Level of Manifestation of Self-Efficacy in Terms of Verbal Persuasion

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Gaining compliment from teachers for being good at learning mathematics	3.23	0.71	Manifested
2. Receiving praise from other people for having talent in doing mathematics	3.25	0.70	Manifested
3. Getting commendation for having good mathematics performance	3.18	0.73	Manifested
4. Obtaining admiration from family members for being a good mathematics student	3.30	0.73	Manifested
5. Being praised by other students for being good at learning mathematics	3.15	0.79	Manifested
6. Being commended for being active participant in mathematics class helps to become more motivated	3.11	0.82	Manifested
7. Hearing uplifting words from teachers increases self-motivation in learning mathematics	3.42	0.69	Manifested
8. Receiving encouragement from friends to take higher level mathematics courses	3.32	0.75	Manifested
9. Getting praise to do well in a mathematics test increases confidence in solving mathematics problems.	3.31	0.72	Manifested
10. Receiving word of encouragement during a board work in mathematics is very motivating.	3.47	0.59	Manifested
11. Attaining admiration after having good grades in mathematics	3.32	0.63	Manifested
Overall	**3.28**	**0.58**	**Manifested**

The results reveal that receiving words of encouragement during a board work heightens students' self-efficacy, hearing uplifting words from teachers increases self-motivation, receiving encouragement from friends to take higher level and attaining admiration after having good grades in mathematics. This means that hearing words of affirmation encourages students to perform well in mathematics class. It is related to the study of Tabibnia (2020) which emphasize that self-affirmation activates the reward centers in your brain, according to a study published in the journal Social Cognitive and Affective Neuroscience (1). It is supported also by Dutcher & Creswell (2018) that hearing affirmations can engage your brain's reward system, which can affect how you deal with both emotional and physical pain.

Table 4 Level of Manifestation of Self-Efficacy in terms of Somatic and Emotional States

Table 4 shows the respondents' level of manifestation of self-efficacy in terms of somatic and emotional state.

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Worrying for being unsure of the mathematics concepts used in problem solving	3.17	0.75	Manifested
2. Getting nervous when being asked to answer questions in mathematics class	3.16	0.73	Manifested
3. Worrying for not being able to answer in mathematics course	3.18	0.75	Manifested
4. Being afraid to give incorrect answer during discussion in mathematics class	3.12	0.79	Manifested
5. Feeling uncomfortable when preparing and taking mathematics test	2.90	0.82	Manifested
6. Worrying for lacking knowledge on mathematics to do well in future mathematics courses	3.14	0.71	Manifested
7. Worrying for underachieving to get good grade in mathematics course	3.03	0.77	Manifested
8. Feeling anxious when preparing for a performance task in math	2.96	0.82	Manifested
9. Worrying for having insufficient mathematical knowledge in future career	3.08	0.79	Manifested
10. Getting nervous when applying mathematical concepts	2.97	0.79	Manifested
11. Being anxious when given unfamiliar mathematical problem	3.14	0.77	Manifested
12. Feeling nervous when leading groupmates in doing performance task in mathematics	3.00	0.85	Manifested
Overall	**3.07**	**0.61**	**Manifested**

The findings show that students worry when they are not able to answer in mathematics courses, for being unsure of the concepts used in problem solving and gets nervous when being asked to answer questions in mathematics class. This implies that the students are having anxiety when tasked to participate in mathematics teaching and learning process. As supported by the study of Daneshamooz & Alamolhodaei (2012), mathematics anxiety is a serious negative emotional reaction to mathematics. "A sensation of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical issues in everyday life and academic contexts," as it is defined.

2. Degree of Exposure to 5E's Instructional Phase

2.1 Engage

Table 5 displays the respondents' degree of exposure to 5E's instructional phase as to engage. It demonstrates that the pre-service teachers are paying attention in class, showing interest in the topic by participating actively, and interacting well with the rest of the class during a math activity.

This indicates that the students are eager to learn mathematics interactively**.** When viewed through a mathematical lens, engagement occurs when students enjoy learning mathematics Rimm-Kaufman et al**. (**2014**).** Students place a high importance on mathematics education when they see links between the math they learn in school and the math they use in their daily lives**.**

Table 5 Degree of Exposure to 5E's Instructional Phases as to Engage

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Demonstrating interest in the lesson by listening attentively in the discussion	3.50	0.56	Highly Exposed
2. Asking questions to satisfy curiosity about the lesson	3.29	0.72	Exposed
3. Responding to questions with enthusiasm	3.14	0.75	Exposed
4. Raising hand in order to answer questions	3.15	0.79	Exposed
5. Making connections to other ideas and offer insights accordingly	3.21	0.74	Exposed
6. Showing interest in the topic by participating actively in the discussion	3.36	0.68	Exposed
7. Providing definitions and answers when being asked	3.17	0.72	Exposed
8. Interacting well with the rest of the group during an activity in math class	3.35	0.65	Exposed
9. Thinking toward the learning outcomes of current activities	3.23	0.67	Exposed
10. Expressing understanding of the topic based on prior knowledge	3.32	0.61	Exposed
11. Sharing own thoughts and ideas in class after listening to other answers	3.19	0.78	Exposed
12. Suggesting ways on how to better understand the lesson	3.21	0.73	Exposed
Overall	**3.26**	**0.54**	**Exposed**

2.2 Explore

Table 6 Degree of Exposure to 5E's Instructional Phases as to Explore

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Determining which pieces of information are useful. Thinking how information can be applied in real-world context.	3.29	0.57	Exposed
2. Addressing more questions related to the topic	3.11	0.76	Exposed
3. Thinking freely but within limits of the activity	3.28	0.63	Exposed
4. Sharing ideas and observations with the group	3.35	0.65	Exposed
5. Collaborating with others to work on alternative solutions	3.42	0.58	Exposed
6. Analyzing or checking for patterns that may be present	3.36	0.56	Exposed
7. Investigating the given questions using known methods to eventually share and expand the results in class	3.15	0.70	Exposed
8. Translating the given questions in a way it can be understood better	3.41	0.69	Exposed
9. Investigating the problem based on what is known	3.39	0.59	Exposed
10. Analyzing patterns that occur during the teaching and learning process	3.35	0.60	Exposed
11. Investigating which proper heuristics can be used in solving given problems	3.25	0.69	Exposed
Overall	**3.31**	**0.50**	**Exposed**

Shown in Table 6 is the respondents' degree of exposure to 5E's instructional phases as to explore. The respondents are exposed to cooperating with others to work on alternate solutions, studying the problem based on what is known, and evaluating or looking for patterns that may be present, as can be observed. This suggests that pre-service teachers value investigating solutions to a given problem. As emphasized in the study of Gurat (2018), problem-solving is especially important in mathematics. The basic purpose of teaching mathematical problem-solving is for students to be able to build a general aptitude to solve real-life problems and apply mathematics to real-life scenario.

2.3 Explain

Table 7 Degree of Exposure to 5E's Instructional Phases as to Explain

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Defining the given terms based on one's own understanding for better comprehension	3.30	0.65	Exposed
2. Using illustrations for better understanding of the given problem	3.38	0.62	Exposed
3. Discussing possible solutions with others	3.38	0.52	Exposed
4. Explaining terms and concepts in one's own words	3.25	0.69	Exposed
5. Demonstrating what was learned by sharing thoughts and ideas on a specific topic	3.27	0.66	Exposed
6. Using recorded observations in giving explanations	3.11	0.81	Exposed
7. Referring to previous activities to clarify an idea	3.35	0.62	Exposed
8. Asking the validity of different explanations heard	3.22	0.72	Exposed
9. Listening to and trying to comprehend the teacher's explanation	3.48	0.54	Exposed
10. Listening critically to others' explanations	3.46	0.60	Exposed
Overall	**3.32**	**0.49**	**Exposed**

Respondents' degree of exposure to 5E's instructional phases as to explain is displayed in Table 7. As can be seen, the pre-service teachers are listening to and trying to grasp the teacher's explanation, critically listening to others' interpretations, utilizing illustrations to better understand the problem, and discussing possible solutions with others. The findings reveal that respondents pay close attention to the topic at hand, share information with others and listen intently to better understand it. Likewise, pre-service teaching practice good listening skills. A competent listener demonstrates readiness and the capacity to turn sound into words and their meaning in context Sadiku (2015). The good listener then connects the meanings offered to other experiences, sharing responsibility with the speaker. When a student can listen more efficiently, he learns more effectively.

2.4 Elaborate

As can be observed, Table 8 shows the respondents exposure to elaboration stage of the 5E's instructional phases. It can be seen that pre-service teachers use previous information to probe, ask questions and make reasonable judgments, apply what was learned to new and unfamiliar situations and give examples based on real-life situations to better understand the lesson. It is in the sense that respondents are able to make connections to understand the relationship of what were familiar and unfamiliar to them. Murata et al. (2012) stated that making connections allows students to grasp how mathematical topics are interconnected and gives them the opportunity to apply number concepts to other areas. Students gain a better understanding of mathematics and regard it as a valuable and exciting subject to study as a result of these linkages.

Table 8 Degree of Exposure to 5E's Instructional Phases as to Elaborate

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Extending one's understanding of the new terms, concept/ problems to new situations	3.30	0.60	Exposed
2. Using previous information to probe, ask questions and make reasonable judgments	3.38	0.61	Exposed
3. Drawing reasonable conclusions and solutions by offering proofs and evidences	3.11	0.67	Exposed
4. Expressing own ideas on a given topic by looking for its connection to real-world context	3.26	0.65	Exposed
5. Using new knowledge and continue to explore its implications	3.22	0.68	Exposed
6. Making connections to other related concepts	3.32	0.66	Exposed
7. Applying what was learned to new and unfamiliar situations	3.36	0.56	Exposed
8. Applying new labels, definitions, explanations and skills in new but similar situations	3.26	0.62	Exposed
9. Integrating gained knowledge to other courses	3.30	0.69	Exposed
10. Drawing reasonable conclusions from gained concepts	3.27	0.66	Exposed
11. Giving examples based on real-life situations to better understand the lesson	3.34	0.65	Exposed
Overall	**3.28**	**0.51**	**Exposed**

2.5 Evaluate

Table 9 Degree of Exposure to 5E's Instructional Phases as to Evaluate

Shown in Table 9 is the exposure of pre-service teachers to 5E's instructional phases as to evaluate. It demonstrates that pre-service teachers use think, pair, and share with classmates to determine the scope of what was studied, summarize concepts/ideas to determine if lessons were learned and understood, and engage in activities that prompt reflection on what has been done, what has been learned, and what remains to be done.

Item Statements	Mean	Standard Deviation	Verbal Interpretation
1. Using think, pair and share with classmates to see the extent of what was learned.	3.42	0.73	Exposed
2. Summarizing the concepts/ideas to see if lessons were learned and understood	3.41	0.64	Exposed
3. Answering open-ended questions by using observations, evidences, and previously accepted explanations	3.40	0.67	Exposed
4. Providing reasonable responses and explanations to given questions	3.29	0.70	Exposed
5. Demonstrating understanding of the concept through models and performance tasks	3.31	0.71	Exposed
6. Asking related questions that encourage future investigations	3.21	0.78	Exposed
7. Reflecting and providing evidence of new understanding of the material	3.28	0.73	Exposed
8. Engaging oneself in activities that prompt to think about what have been done, what have been learned, and what still need to do	3.41	0.60	Exposed
9. Trying to connect and relate the topic to real-world context to see its importance	3.35	0.66	Exposed
10. Providing multiple representations to check better understanding of the learned concepts	3.34	0.66	Exposed
Overall	**3.34**	**0.57**	**Exposed**

This concludes that pre-service teachers place a high emphasis on self-evaluation to ascertain whether or not they have grasped the topic. Sharma et al. (2016) focused on the impact of self-assessment by students on their learning. Students' enthusiasm and motivation for subjects can be increased through self-assessment, resulting in improved learning and academic achievement, as well as the development of critical abilities for analyzing their own work.

3. Relationship between the Respondents' Level of Manifestation of Self-efficacy and the Degree of Exposure to 5E's Instructional Phases

Table 10 reveals the relationship between the respondents' level of manifestation of self-efficacy and the degree of their exposure to 5E's instructional phases.

The table shows that when the respondents' level of manifestation of self-efficacy were correlated with the degree of their exposure to 5E's instructional phases, the computed Pearson's r value is 0.81 and the probability value of 0.000 revealed that there is adequate evidence at 0.01 level of significance to reject the null hypothesis and confirm that the respondents' manifestation level of self-efficacy and exposure to 5E's instructional phases are related.

Table 10 Relationship between the Respondents' Level of Manifestation of Self-efficacy and the Degree of Exposure to 5E's Instructional Phases

Variables	Computed Pearson r	p value	Decision H_0	Interpretation
Self-efficacy and 5E's Instructional Phases	0.81	.000	Reject H_0	Significant

$\alpha = 0.01$

This finding implies that the respondents' manifestation level of self-efficacy is significantly related to the degree of exposure to 5E's instructional phases. This indicates that as the degree of students' exposure to 5E's instructional phases increases, their manifestation level of self-efficacy also increases.

4. Discourses on Self-Efficacy through Exposure on 5E's

Students' attention and focus are improved when they are actively involved in the learning process. They are also motivated to practice higher-level critical thinking abilities and have more meaningful learning experiences. Instructors that use a student-centered approach to instruction boost student engagement, which helps everyone achieve the course's learning objectives more successfully. To determine the discourses on self-efficacy through exposure on 5E's instructional phases, selected participants underwent a Focus Group Discussion (FGD). Themes and subthemes emerged from the text data are presented in Table 13.

The analysis of the participants' responses on the conducted interview reveals three major themes. These themes include mathematics learning experiences, factors affecting self-efficacy and exposure to 5E's. Participants perceived mathematics as a challenging subject as they reflect on their mathematics learning experiences. However, even though it is challenging, they found it thrilling, fulfilling and engaging. A participant describes his learning experiences in mathematics as follows:

Table 11 Discourses on Self-Efficacy through Exposure on 5E's

The table summarizes the key findings from a focus group discussion, which revolves around three main themes related to mathematics learning experiences and self-efficacy. The first theme, "Mathematics Learning Experiences," is divided into two subthemes: "Mathematics is challenging" and "Mathematics is engaging." Under "Mathematics is challenging," participants express their perception that learning mathematics is difficult, but they also find it fulfilling and engaging. They note that competent teachers and various learning methods, such as online group discussions and YouTube video tutorials, can make mathematics an engaging experience. The second theme, "Factors Affecting Self-Efficacy," includes two subthemes: "Correct answers" and "Incorrect answers." Participants highlight the positive impact of getting the right answers, which leads to fulfillment, satisfaction, and increased motivation to solve more problems. They also recognize the value of incorrect answers as opportunities for growth, increased motivation, and reflection on their learning. The third theme, "Exposure to 5E's," relates to a teaching approach characterized by five phases: Engage, Explore, Explain, Elaborate, and Evaluate. This approach is seen as highly interactive, student-centered, and conducive to active learning, which, in turn, enhances self-efficacy by encouraging student participation at every stage of the learning process. These findings provide valuable insights for educators and curriculum designers looking to improve mathematics education and boost students' confidence in the subject.

Themes	Subthemes	Exemplar Texts
Mathematics Learning Experiences	Mathematics is challenging	1. Learning mathematics is challenging but fulfilling. [P1]
		2. Math is challenging but thrilling to learn, especially when the teacher is competent. [P2]
	Mathematics is engaging	3. Use of google meet for online group discussion. [P10]
		4. Watching youtube video tutorials to further understand the lesson. [P6]
		5. Familiarization with problem-solving formulas and processes through collaborating with peers. [P3]
Factors affecting self-efficacy	Correct answers	1. Being able to get the right answer gives fulfillment and satisfaction. [P4]
		2. heightens motivation to answer more related problems. [P1]
	Incorrect answers	3. Incorrect answers give motivation to strive harder. [P5]
		4. Allows for additional exploration in order to gain a better understanding. [P8]
		5. Opens door to evaluate and reflect on one's learning. [P7]
		6. Gives more thrill in solving problems. [P3]
Exposure to 5E's	Increased self-efficacy	1. Highly interactive and student-centered. [P9]
		2. Gives emphasis to learning as an active process and value student engagement. [P6]
		3. Learning is strengthened since occurs in every phase. [P5]
		4. Develops active participation among students which heightens students' self-efficacy. [P3]

Proposed Mathematics Learning Guide

Mathematics learning guide is presented as an output of the study for evaluation and utilization of mathematics instructors in exposing students to the 5E's instructional phases in order to improve their self-efficacy in mathematics**.** Students' metacognition, or awareness of and knowledge of their own learning, as well as their capacity to better regulate their learning, are aided by this learning guide**.** It is a useful piece of knowledge that can assist students in the learning process by providing them with information, allowing them to govern their learning, and enabling them to regulate their activities**.**

Mathematics Learning Guide

Introduction

Mathematics, as perceived by many, is challenging to teach and understand. Nevertheless, teachers are the most essential influence in student achievement inside the school system. Teachers who have mastered effective ways and strategies for teaching and designing learning activities in mathematics can assist students in improving their mathematical knowledge and outcomes. Thus, effective mathematics teaching creates defined goals for students' learning of mathematics, places goals inside learning progressions, and uses the goals to guide instructional decisions.

Using the 5E instructional phases to teach and design learning activities in mathematics allows educators to provide students with a unique learning experience. Teachers that can implement instructional models like the 5E Model into their classrooms help students create a firm foundation of knowledge by engaging them in active learning. They emphasize possibilities to tailor learning through this method. Because students are actively involved in the teaching and learning process and have the opportunity to collaborate with peers, they are more at ease when learning mathematical ideas, resulting in a more conducive learning environment that reduces fear of math and enhances self-efficacy.

Parts of the Learning Guide:

The mathematics learning guide is designed for instructors seeking to enhance students' self-efficacy in mathematics through exposure to the 5E instructional phases. It comprises the following parts:

Engage:

Initiate discussions or activities related to the upcoming math lesson.

Provide opportunities for students to observe and wonder about mathematical concepts.

Explore:

Facilitate experiences that allow students to explore mathematical concepts or skills.

Aim for a common experience that students and teachers can later refer to when explaining new concepts.

Explain:

Present the topic or skill during this phase.

Encourage students to articulate their understanding, with teacher support as needed.

Elaborate:

Enable students to extend their understanding and apply concepts to new situations.

Foster collaboration to address misunderstandings and deepen comprehension.

Evaluate:

Assess student learning at the end of the unit.

Conduct formative assessments throughout each phase, with summative assessment at the conclusion.

Discussions

The respondents' level of self-efficacy in terms of vicarious experience is highest, followed by verbal persuasion, mastery experience, and somatic and emotional state (Villas, 2019). This implies that individuals in the studies had the most confidence in their ability to perform tasks when they observed others successfully completing similar tasks (vicarious experience). Verbal persuasion, such as receiving encouragement or positive feedback, also played a significant role in boosting self-efficacy. Mastery experience, which refers to personal achievements and successes, was another important factor influencing self-efficacy.

Moreover, the findings suggest that individuals' beliefs about their own capabilities are influenced by various factors, and understanding these sources of self-efficacy can have implications for educational practices and interventions.

On the other hand, pre-service teachers value the use of 5Es instructional phases in delivering instruction in mathematics as they actively involve themselves in the teaching and learning process. It recognizes the significant role these phases play in fostering their engagement and understanding of mathematical concepts.

Conclusion and suggestions

Considering the above results, the pre-service teachers' level of manifestation of self-efficacy is significantly related to the degree of exposure to 5Es instructional phases. It emphasizes the pivotal role that the 5E's instructional approach plays in shaping their self-confidence and competence in mathematics education. Also, it reveals a direct and influential connection between the students' confidence in their mathematical abilities and their active engagement with the 5E's instructional model.

The following were made based on the finding of the study:

The researcher-made mathematics learning guide may be tried and be utilized to see how effective it is at increasing students' self-efficacy in mathematics.

Pre-service teachers may contemplate and utilize varied learning strategies to master mathematical concepts so as to boost their self-efficacy in mathematics and instructors may consider innovation and modification of instructional practices in delivering instructions and designing learning experiences based on 5E's model that will help boost students' self-efficacy in mathematics.

Future researchers may conduct similar studies to further identify other factors that may influence student's self-efficacy as exposed to 5E's instructional phases.

New knowledge and the effects on society and communities

The recent research findings shed light on the multifaceted nature of self-efficacy. The study revealed that self-efficacy is most pronounced when individuals observe others successfully completing similar tasks, a phenomenon known as vicarious experience. Following closely, verbal persuasion, which involves receiving encouragement and positive feedback, was identified as a substantial contributor to self-efficacy. Moreover, the research emphasized the significance of mastery experience, encompassing personal achievements and successes, as an influential factor in bolstering one's self-efficacy.

These findings hold significant implications for society, particularly in the realm of education and personal development. Recognizing the sources of self-efficacy can inform educational practices and interventions, ultimately aiding individuals in their pursuit of tasks and goals. By understanding the interplay of these factors, educators and counselors can better support and nurture the self-efficacy of students and individuals, enabling them to thrive and overcome challenges in various domains.

In the domain of education, the research also uncovered the value of the 5Es instructional phases for pre-service teachers when delivering mathematics instruction. These phases actively engage educators in the teaching and learning process, highlighting their pivotal role in facilitating comprehension and engagement with mathematical concepts. Consequently, this approach has the potential to enhance the quality of mathematics education.

Furthermore, the study demonstrated that pre-service teachers' self-efficacy in mathematics can be significantly improved by incorporating the 5E's Instructional phases with the aid of a researcher-made mathematics learning guide. This presents an exciting opportunity to empower future educators and, in turn, positively impact the learning experiences of students. By equipping teachers with effective tools and strategies, the research has the potential to enhance the overall quality of math education in local communities and beyond. In essence, these findings illuminate a pathway towards fostering a more confident and engaged generation of educators and learners.

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