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Impact of pre-service teachers' self-regulation and self-efficacy on their mathematics performance in blended learning

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Article Info	ABSTRACT
	This research investigated the pre-service teachers' self-regulation, self-efficacy, and mathematics performance in blended learning during the post Coronavirus disease 2019 (COVID-19) pandemic in a state university using a descriptive correlational design. There were 201 pre-service teachers who were identified using simple random sampling. They answered the two-set survey questionnaire, which assessed their self-regulation and self-efficacy, while their performances were assessed using their grades in the subject. The data gathered were treated using descriptive and inferential statistics. The results revealed that they had high self-regulation while they had a very high level of self-efficacy. At the same time, they had a very satisfactory performance in mathematics. Moreover, their self-regulation in terms of planning, monitoring, and adjusting was significantly correlated with their math performance while reflecting is not. However, no significant relationship was found between their self-efficacy and mathematics performance. Thus, instructors are encouraged to conduct monitoring during blended learning to encourage pre-service teachers to maintain their high level of self-regulation and self-efficacy in learning mathematics. In addition, future researchers may explore the same variables to validate the findings of the study because these findings are limited only to pre-service teachers and were conducted during the post COVID-19 pandemic.

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1. INTRODUCTION

Coronavirus disease 2019 (COVID-19) pandemic has remarkably affected the educational system around the world wherein schools and universities shift from face-to-face classes to online and modular instruction to minimize further virus transmission [1], [2]. Countries worldwide have adopted new learning modalities to ensure continuous education despite the pandemic [3]. In these new learning modalities, students are no longer required to report to school to receive education [4]. Schools and universities implement a learning modality that is practical to the needs and characteristics of their learners [5].

In the Philippines, blended learning is one of the modalities most universities adopt, combining synchronous learning, and asynchronous learning. Synchronous learning is conducted through real-time video conferencing, where virtual interaction between instructors and students occurs. Instructors conduct lectures and consultations with students where they can ask questions or participate in the discussion [1]. On the other hand, asynchronous learning is conducted by providing lecture videos or digitized modules using online platforms [6]. Students are given a chance to learn the lessons through the instructional materials provided by the instructors, together with the assigned tasks. Students have the flexibility of their schedule to

perform the activities required in the modules because some reside in areas without reliable internet access [7].

With the decline of the COVID-19 cases and the pandemic is no longer at high risk, some schools, and universities in the Philippines started to implement limited face-to-face classes while other universities opted to continue implementing the blended learning because of the positive feedback from students like having more relaxed schedules compared to regular classes giving them opportunity to keep up with the courses taught [8]. Blended learning is considered the modern educational system which provides more opportunities for teachers to transmit knowledge and experiences to students to acquire the utmost learning outcomes [9] such as integrating digital technology [10] students' autonomy over their learning [11] and optimising student engagement [12]. Blended learning positively affects the student's learning process because it enhances the learning outcomes, increases motivation, improves students' participation, and effectively achieves the desired learning objectives [7], [13].

Although blended learning provides more advantages to students' learning [13], some factors pose challenges in its implementation, like how the students can utilize technology effectively and maintain their commitment to learning while learning at home [14]. Challenges may occur when students need more skills in exploring the technology, unavailability of gadgets, and unstable internet connection [15]. Additionally, the flexibility of the schedule that the modality offers to the students can put them at risk of being complacent in accomplishing their tasks. Moreover, students are new to this learning modality which requires them to adjust to the new educational setup. Thus, students need to develop self-regulation because the responsibility to learn their subjects depends more on their efforts. After all, teachers cannot monitor their activities while performing their tasks. Students who have developed self-regulation are aware of circumstances that could contribute to their success through self-reflection. These circumstances include their self-discipline, focus on their school tasks, time management, and avoidance of distractions. Self-reflection includes a self-judgment and self-reaction process of one's performance that is attributed to the success or failure of the given tasks [16]. The student's assessment of whether they had failed or succeeded with their goals can be attributed to their self-efficacy [17].

Self-efficacy is a person's assessment of his or her capacity to complete specified tasks [18]–[20]. It influences people's thinking patterns and emotional responses, how much effort they put into an activity, how long they persevere when faced with challenges, and how resilient they will be in unpleasant situations [21]. People with high efficacy view tough jobs as challenges to be overcome rather than threats to be avoided [22]. Mastery experiences shape self-efficacy beliefs by interpreting performance on specific tasks [23]. Furthermore, self-efficacy beliefs influence an individual's development and change by selecting life choices and possibilities [24], [25]. Self-efficacy has also been connected to using deep learning methodologies, high motivation, and a favourable attitude toward mathematics.

On the other hand, a soft feeling of self-efficacy has been associated with using surface learning methodologies, high mathematics anxiety, and a lack of enthusiasm for mathematics [26], [27]. Students with high self-efficacy can perform better in math because they can carry out higher cognitively, have extra motivation to face difficulties, have much less math anxiety, and are more interested to learn mathematics [28]. In the classroom, teachers must allow students to learn math more successfully through different learning tasks accomplished individually, in pairs, or in groups. These successful experiences improve student performance in mathematics and further contribute to the development of beliefs about self-efficacy in mathematics. In addition, the presence of teachers and classmates in the classroom setting can encourage students to improve their performance in school [25].

One of the challenges students need to overcome in blended learning is the absence of a classroom environment where they can frequently interact with their teachers and classmates about their lessons [29], especially in subjects that they consider challenging to learn, such as mathematics [30], [31]. Most of the time, students are left alone while learning their lessons. Thus, university students must develop self-regulation learning strategies because mastering the subject is part of the learning goal [32]. In self-regulation, students can reflect on their performance in the subject. In addition, students need to determine their effectiveness in learning their lessons while away from school since they are new to this mode of learning. Particularly in the Philippines, this has yet to be investigated by researchers during this post pandemic to provide information about pre-service teachers' self-regulation, and self-efficacy and how these affect their performance in mathematics. Hence, there is a need to investigate the self-regulation of pre-service teachers while learning away from school and their self-efficacy. Furthermore, it looked into the effects of these variables on their math performance to address issues relevant to blended learning adopted by the universities. Specifically, this paper aims to explore the following problems:

a. To determine the level of self-regulation of the pre-service teachers
b. To determine the level of self-efficacy of the pre-service teachers
c. To determine the math performance of the pre-service teachers
d. To test the relationship between the pre-service teachers' self-regulation and math performance

e. To test the relationship between the pre-service teachers' self-efficacy and math performance

2. RESEARCH METHOD

This section presents the research method, participants, data collection tools, data collection process, and data analysis. This research utilized a descriptive correlational design to test the relationship between self-regulation and self-efficacy on the math performance of the pre-service teachers engaged in blended learning during the post COVID-19 pandemic. A correlational research design aims to determine the relationship between two or more variables without the intent of controlling any of these variables [33]. The self-regulation and self-efficacy of the respondents were assessed using a survey questionnaire, while their performance in mathematics was assessed using their grades in their math subjects. Furthermore, the data gathered from these variables were used to test the following null hypotheses:

a. Ho_1: there is no significant relationship between self-regulation and the academic performance of the pre-service teachers in mathematics
b. Ho_2: there is no significant relationship between the self-efficacy and academic performance of the pre-service teachers in mathematics

This study was conducted at a state university in Cebu City, Philippines. The respondents were first to third year students enrolled in the first semester of the school year 2021–2022 at the university taking up a Bachelor of Secondary Education major in Mathematics. These students were chosen as the respondents because they enrolled in math subjects for the given semester. The profile of the respondents in terms of their gender, age, and year level is presented in Table 1.

Table 1. Profile of the respondents

Profile	f	%
Gender		
Male	37	18.41
Female	164	81.59
Total	201	100.00
Age (in years)		
22 and above	27	13.43
20–21	98	48.76
18–19	76	37.81
Total	201	100.00
Year level		
Third year	81	40.30
Second year	20	9.95
First year	100	49.75
Total	201	100.00

It can be gleaned from Table 1 that 164 (81.59%) of the respondents are female students who comprise the majority of the respondents. On the other hand, 98 (48.76%) of them are aged from 20 to 21 years old. Interestingly, 100 (49.75%) first year students participated in the study. The data illustrate that most of the study's pre-service teachers are first year students.

The data collected in this study utilized an adopted self-regulation questionnaire [34] to assess the respondents' level of self-regulation, which has 22 items categorised into four components: planning, monitoring, adjusting, and reflecting. The respondents were asked to rate the items based on their self-regulation self-assessment using a 5-point Likert scale from 1 (Not Very Like Me) to 5 (Very Like Me). On the other hand, the respondents' self-efficacy was assessed using the adopted self-efficacy questionnaire [35], which has 13 items. The respondents were asked to rate their level of self-efficacy using 5-point Likert scale from 1 (Not Very Like Me) to 5 (Very Like Me). Lastly, the respondents' mathematics performance was assessed using their final grades in their mathematics subjects. The researcher asked assistance from the respondents' subject teachers in retrieving their grades in mathematics.

Before the data gathering was conducted, the university's protocol for conducting research involving the students was compiled. Moreover, the researcher asked assistance from the respondents' subject teachers in orienting the students on the purpose and their need to participate in providing salient information about the study. Simple random sampling was used to initially determine who will participate in the study. Informed consent was secured before the students were finally identified to be part of the data-gathering process. Students were informed of their right to withdraw anytime when they feel uncomfortable with the process. Students provide the data through the two survey questionnaires administered using Google from the link provided to them. They were given enough time to answer the questionnaire and at their most convenient

time. The data were retrieved through the spreadsheets created electronically. The researcher ensured the confidentiality of the data provided by the respondents and was stored properly.

The data collected were tallied, organized, summarized, and analyzed using descriptive and inferential statistics. Frequency and percentage were used to describe the distribution of the respondents' profile and the performance in mathematics. Mean and standard deviation (SD) were used to determine the overall performance of the respondents in mathematics and to describe the spread of their grades, respectively. The academic performance was described using the following scale: 90 – 100 (outstanding), 85 – 89 (very satisfactory), 80 – 84 (satisfactory), 75 – 79 (fairly satisfactory), below 75 (poor). Weighted mean was used to determine the level of self-regulation and self-efficacy of the respondents. Pearson's *r* was used to test the relationship between self-regulation, self-efficacy, and the academic performance of the respondents in mathematics.

3. RESULTS AND DISCUSSION
3.1. Results

This section presents the results of the data gathered from the respondents in terms of their self-regulation, self-efficacy, and math performance. It also includes the test of relationship between these variables. Table 2 shows the level of self-regulation of the pre-service teachers in terms of planning with an aggregate mean of 3.84 indicating that they have a high level of self-regulation. It can be noted that the pre-service teachers highly prioritised finishing their projects and getting things done before having fun. However, they need to improve in formulating plans that would assist them in achieving their objectives. It can be gleaned from Table 3 the level of self-regulation of the pre-service teachers in terms of monitoring that reflects an aggregate mean of 3.84 indicating that they have a high level of self-regulation in terms of monitoring their tasks. It is reflected in Table 4 that the pre-service teachers have a high level of self-regulation in terms of adjusting to their situation with an aggregate mean of 3.84. This result can be observed in their very high responses to the statements describing their efforts to complete their work on time, taking action on things that are not getting right, and their diligence in pursuing to achieve success in what they are doing.

Table 2. Level of self-regulation of the pre-service teachers (planning)

S/N	Indicators	WM	Verbal description
1	I make a list of projects that I want to finish.	4.24	Very high
2	If I have a big test coming up, I develop a study plan.	4.03	High
3	I think about all the things I need to get done before I do something fun.	4.34	Very high
4	I can typically anticipate how long it will take me to finish my schoolwork.	3.84	High
5	I have a hard time formulating plans to assist me achieve my objectives.	2.72	Moderate
	Aggregate mean	3.84	High

Legend; 4.21 – 5.00: very high; 3.41 – 4.20: high; 2.61 – 3.40: moderate; 1.81 – 2.60: low; 1.00 – 1.80: very low.

Table 3. Level of self-regulation of the pre-service teachers (monitoring)

S/N	Indicators	WM	Verbal description
1	I kept track of how my projects are going.	4.19	High
2	I know when I'm behind on a project.	4.31	Very high
3	I keep track of my progress toward my goal.	4.13	High
4	At any given time, I'm aware of my grades.	3.45	High
5	I make a list of things I need to do every day and keep track of what I accomplish.	4.16	High
6	I have a hard time remembering everything I need to do.	2.82	Moderate
	Aggregate mean	3.84	High

Table 4. Level of self-regulation of the pre-service teachers (adjusting)

S/N	Indicators	WM	Verbal description
1	I go to great extents to complete my work on time.	4.23	Very high
2	I make decisions that will help me achieve, even if they aren't the most enjoyable at the time.	4.06	High
3	I want to take action as soon as I notice something isn't working.	4.21	Very high
4	To succeed, I continue to attempt as many diverse options as possible.	4.23	Very high
5	When it comes to projects that take a long time to accomplish, I find it difficult to stay focused.	2.43	Low
6	When I'm behind on my work, I'm prone to giving up.	3.89	High
	Aggregate mean	3.84	High

Table 5 presents the level of self-regulation of the pre-service teachers in terms of reflecting on what they are doing with an aggregate mean of 3.93 which indicates that they have a high level of reflection on the things that they have done. The results show that they always assess how well they perform their tasks and learn from those mistakes. Table 6 presents the summary of the level of self-regulation of the pre-service teachers with a grand mean of 3.86 which shows that they have high self-regulation. The students claimed that they practiced a high level of self-regulation in terms of the four components assessing this variable.

Table 5. Level of self-regulation of the pre-service teachers (reflecting)

S/N	Indicators	WM	Verbal description
1	I consider how well I'm doing on my homework.	3.95	High
2	When I complete all of my tasks on schedule, I feel accomplished.	4.66	Very high
3	When I create new goals, I consider how well I've done previously.	4.08	High
4	I attempt to learn from my mistakes when I fail at something.	4.42	Very high
5	Time after time, I make the same error.	2.56	Very high
	Aggregate mean	3.93	High

Table 6. Summary on the level of self-regulation of the pre-service teachers

Components	WM	Verbal description
Planning	3.84	High
Monitoring	3.84	High
Adjusting	3.84	High
Reflecting	3.93	High
Grand mean	3.86	High

Table 7 presents the level of self-efficacy of the pre-service teachers with an aggregate mean of 4.27 which indicates that they have a very high self-efficacy. In line with students claimed of their high level of self-regulation, they also feel that they are very effective in learning mathematics despite learning the subject in a new educational setup. Table 8 presents the level of academic performance of the pre-service teachers in math. It can be observed that 110 (54.73%) of the pre-service teachers had a very satisfactory grades ranging from 85 to 89 while 66 (32.84%) of them had an outstanding performance with a grade range of 90 - 100. There were also 24 (11.94%) of them who had satisfactory performance with a grade range of 80 - 84 and one (0.50%) of them had fairly satisfactory performance. Generally, they had a very satisfactory performance based on their mean grade of 87.84 with a 3.14 SD.

Table 9 shows the results of the test of a significant relationship between self-regulation and math performance of the pre-service teachers. The results of the statistics show that planning ($r = 0.279$, $p < 0.01$), monitoring ($r = 0.188$, $p < 0.01$), adjusting ($r = 0.153$, $p < 0.05$), and reflecting ($r = 0.054$, $p > 0.05$) which indicate that planning, monitoring, and adjusting are significantly related to the math performance of the pre-service teachers while reflecting has no correlation with their math performance. Table 10 presents the test of relationship between the self-efficacy and math performance of the pre-service teachers. With the computed statistics, $r = 0.123$, $p = 0.081$, the results suggest that self-efficacy is not significantly related to the math performance of the pre-service teachers.

Table 7. Level of self-efficacy of the pre-service teachers

S/N	Indicators	WM	Verbal description
1	This year, I will be able to understand what has been taught in class.	3.83	High
2	If I work hard enough, I can figure out anything.	4.16	High
3	If I practiced every day, I could develop just about any skill.	4.26	Very high
4	I keep attempting to complete anything essential to me once I've decided to do it, even if it's more difficult than I anticipated.	4.40	Very high
5	I feel confident in my ability to attain the objectives I have set for myself.	4.24	Very high
6	Instead of getting discouraged when I'm working on a difficult task, I concentrate on my progress.	4.19	High
7	Whatever career track I select, I will be successful.	4.11	High
8	Whatever college major I choose, I will be successful.	4.30	Very high
9	I believe hard work pays off.	4.70	Very high
10	My ability grows with effort.	4.47	Very high
11	I believe that the brain can grow and expand similarly to a muscle.	4.43	Very high
12	I believe that anyone, regardless of background, can dramatically improve their depth of talent.	4.36	Very high
13	I have a lot of control over my basic level of skill.	4.05	High
	Aggregate mean	4.27	Very high

Legend; 4.21 – 5.00: very high; 3.41 – 4.20: high; 2.61 – 3.40: moderate; 1.81 – 2.60: low; 1.00 – 1.80: very low.

Table 8. Level of math performance of the pre-service teachers

Level	Numerical range	f	%
Outstanding	90 – 100	66	32.84
Very satisfactory	85 – 89	110	54.73
Satisfactory	80 – 84	24	11.94
Fairly satisfactory	75 – 79	1	0.50
Poor	Below 75	0	0.00
Total		201	100.00
Mean		87.84	
SD		3.14	

Table 9. Correlation analysis on self-regulation and math performance

Math performance versus	r-value	Strength of correlation	p-value	Decision	Result
Planning	0.279**	Negligible positive	0.000	Reject Ho	Significant
Monitoring	0.188**	Negligible positive	0.008	Reject Ho	Significant
Adjusting	0.153*	Negligible positive	0.031	Reject Ho	Significant
Reflecting	0.054	Negligible positive	0.442	Do not reject Ho	Not significant

*Significant at $p < 0.05$; ** Significant at $p < 0.01$.

Table 10. Correlation analysis on self-efficacy and math performance

Variables	r-value	Strength of correlation	p-value	Decision	Result
Self-efficacy and math performance	0.123	Negligible positive	0.081	Do not reject Ho	Not significant

*Significant at $p < 0.05$.

3.2. Discussion

Based on the results, the pre-service teachers claimed that they are always aware when they are already behind on a project however they need to improve in remembering things that they need to do. The pre-service teachers claimed to have high self-regulation in terms of planning their activities. Blended learning encourages students' autonomy in learning their lessons. Students have the freedom to choose and plan out when to perform their school tasks because they have complete control of their time for learning. Thus, students need to identify what activities are productive and focus on the tasks that lead to successful academic outcomes [36]. Moreover, the absence of the teachers while learning their lessons requires the pre-service teachers to conduct self-monitoring of their performance in school. Their high self-regulation in terms of monitoring their performance in school will be helpful in identifying what areas they need to improve and have to maintain. Students' monitoring of their submissions to the assignments and projects in school would remind them which tasks they are able to submit on time and which they have submitted late. Self-monitoring helps pre-service teachers to identify in which areas they need to adjust to cope with the challenges they encounter and improve their performance [37]. Students need to monitor their performance in order to see their effectiveness and modify their strategies to have more productive engagement in their learning activities [38]. On the other hand, students' assessment of their performance against their goal can determine their success or failure. Students who have a high level of self-reflection are more aware of the progress of their performance and goals [39].

Consequently, the self-efficacy of the students is derived from their perception of how they perform in school. The pre-service teachers reported that they have a very high level of self-efficacy. This is the result of their beliefs on how well they perform while engaging in blended learning. The students believe that they have exerted much effort in every activity given to them, extend their perseverance whenever they encounter challenges, and practice resiliency during this time of the post pandemic [21]. Moreover, students with high self-efficacy exert more efforts in performing their tasks and extend their time accomplishing their school tasks than those with lower self-efficacy [40].

Interestingly, the pre-service teachers showed very satisfactory performance in their math subjects. Most university students are already mature in their decisions which can help them adjust to new situations. They are able to easily cope with challenges that they encounter like their school-related tasks [41]. Moreover, university students are usually exposed to independent learning which is needed in blended learning. Thus, exposing these students to blended learning require less effort from them although the new setup could possibly influence their behaviour towards learning with prolonged engagement in this modality [42], [43]. Moreover, it is important to assess the effects of this modality on the students on a regular basis so that intervention can be provided for issues relative to this.

The test of hypothesis on the relationship between self-regulation and mathematics performance of the pre-service teachers showed significant results in the areas of planning, monitoring, and adjusting. The results imply that self-regulation has a significant contribution to mathematics achievement [44]–[46].

Furthermore, it is one of the crucial factors that contribute to mathematics learning by restraining distractive thoughts and environment [37], [47]. Corollary to this, students with high self-regulation would result to high mathematics achievement [48], [49].

However, the self-efficacy of the pre-service teachers revealed no significant relationship with their academic performance in mathematics suggesting that their self-efficacy does not affect their performance in mathematics while engaging in blended learning. This finding contradicts the previous results which found that self-efficacy has influence on students' math achievement [50]–[56]. The results imply that the pre-service teachers' assessment of how much effort they exerted while learning away from school does influence their performance in the subject. These findings that contradict the previous findings can be due to the different learning modality that the students are engaged in. Students can feel more of their own responsibility while learning away from school because of the absence of teachers to monitor their performance. As such, they have to double their efforts in monitoring their activities and compliance with the school requirements while learning the lessons at their most convenient time. Thus, if students feel that they are able to comply with the school requirements while having the freedom to choose when to perform the tasks and assignments then they feel that their strategies in learning are very effective. However, this does not guarantee that they really perform well in their subjects.

4. CONCLUSION

The present study examined the effects of self-regulation and self-efficacy of the pre-service teachers on their math performance while engaging in blended learning. The high self-regulation of the pre-service teachers manifest that they are already responsible in their studies because they are able to manage their time and prioritized their tasks to comply with the school requirements despite the absence of their teachers. Teachers do not need to have constant monitoring so that they can perform their tasks on time. On the other hand, their high self-efficacy indicates that they can still learn effectively despite learning away from school. The good results of the pre-service teachers' self-assessment are supported by very satisfactory math performance. It is noteworthy to conclude that learning alone is not a hindrance for them to learn the subject effectively. On the other hand, their self-regulation has contributed to their commendable performance in the subject. Although their self-efficacy does not suggest having effects on their performance yet it cannot be discounted to possibly help the pre-service teachers' struggles during the post COVID-19 pandemic. Thus, it is highly recommended that the university will regularly evaluate the modality implemented to address the issues and concerns identified to improve its implementation. Similarly, teachers will conduct monitoring in the delivery of instruction as this could help the pre-service teachers enhance their self-regulation and self-efficacy to achieve a better performance in the subject. Moreover, university students are encouraged to practice high self-regulation strategies to monitor their performance and learn effectively while engaging in blended learning. Furthermore, due to the limited scope of this study, researchers are encouraged to explore the same variables on a different setting to validate this study's findings.

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