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Self-Efficacy in Learning Mathematics Online

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ABSTRACT

Online learning has been a need for worldwide education systems due to Covid-19. It is essential to study the students' self-efficacy to determine online learning success. Research suggests that self-efficacy can boost student achievement, foster emotional health and well-being, and be a valid predictor of motivation and learning. The purpose of this paper is to examine the students' self-efficacy in Mathematics online learning using a reliable instrument adapted from the "Learning Self-Efficacy Scale (OLSES)" developed by Zimmerman and Kulikowich in 2016. The respondents consisted of 343 undergraduate students in Sarawak, Malaysia. This study's quantitative data analysis methods include descriptive and inferential statistics. The analysis reported that most of the respondents had moderate to high levels of self-efficacy, whereas most of them were comfortable with Mathematics online learning. Specifically, there was a significant relationship between students' self-efficacy and the domains, namely learning in an online environment, time management, and technology use. This study also found no significant difference in the mean scores of students' self-efficacy concerning gender, academic performance, and online learning prior experience. However, there was a significant difference in mean scores for students' self-efficacy across their online learning comfort levels. Further analysis indicated that students who were notably comfortable projected a significantly higher self-efficacy than those with an average or low comfort level. Although the students in this study mostly had moderate to high levels of self-efficacy, there is still room to improve and strengthen their self-efficacy, especially in their abilities and readiness to engage in online learning and thus in achieving good academic performance.

Keywords: self-efficacy, comfort level, OLSES, Mathematics, online learning

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1 INTRODUCTION

The rapid spread of coronavirus (Covid-19) outbreaks since the pandemic hit the world in March 2020 has led higher learning institutions to switch classes to online learning to ensure the learning process is continued and delivered. Although online learning has many advantages (Rawashdeh et al., 2021; Mukhtar et al., 2020; You & Kang, 2014), the sudden switch to online learning has caused anxiety among students about their academic performance and future (Browning et al., 2021, Cao et al., 2020; Wang et al. 2020). Through an appropriate platform and strategies, online learning can be as effective or better than traditional face-to-face classroom (Songkram et al., 2015; Maki & Maki, 2007; Westhuis et al., 2006; Robertson, Grant, & Jackson, 2005). Numerous studies revealed self-efficacy as a critical component of academic success in online learning. Self-efficacy is a good predictor (Alivernini & Lucidi, 2011) and an important psychological factor (Yavuzalp & Bahçivan, 2020) of academic success as it assists students in adapting well to new learning environments. Students with a reportedly high level of self-efficacy are more likely to succeed in online learning (Zimmerman & Kulikowich, 2016). This paper aims to share some findings on undergraduate students' self-efficacy, particularly in Mathematics online learning, and examine the variables that affect students' self-efficacy, such as gender, academic performance, prior experience, and comfort level towards Mathematics online learning.

2 BACKGROUND

Online learning refers to learning that occurs partially or entirely over the internet (Means et al., 2010) using any virtual learning platforms. Students can learn from distance and various places but have enough facilities such as electronic devices and good coverage to ensure a smooth learning process. Students can also complete their courses through online learning (Educations Media Group, 2021). One of the teaching methods for Mathematics courses before the Covid-19 pandemic was an expository method. It is a common method of direct lecture in which the lecturer or teacher stands in front of the class and students take notes (Prayekti, 2016). In comparison, Moreno-Guerrero et al. (2020) found that online learning has proven more effective for Mathematics subjects than the traditional expository method. According to Ichinose (2010), the students' belief in Mathematics helps them learn Mathematics. Thabet and Kalyankar (2014) discovered that students' performance in learning the fraction Mathematics course had improved significantly after using online learning.

Furthermore, a study comparing the performance of synchronous and asynchronous online learning methods in Mathematics discovered that synchronous online learning yielded better results (Libasin et al., 2021). Moreno-Guerrero et al. (2020) concluded that the online learning method positively impacted adult learners in mathematical subjects. The findings revealed that online learning improved students' results and positively influenced their motivation, engagement, autonomy, and mathematical concepts. Similarly, a study done by Sutriyani (2020) has found that online learning during the Covid-19 pandemic positively impacts Mathematics learning outcomes. Besides, video recording has been discovered to be a powerful technique for coaching and gaining knowledge of Mathematics (Ndungo, 2021). It can help students replay and watch the lesson many times in their own free time.

Bandura (1977) defined self-efficacy as the belief regarding the self-assessment of one's capability to execute required behaviours to produce specific performance attainments. According to Bandura, people with high self-efficacy, which refers to those who believe they can perform well, are more likely to view complex tasks as something to be mastered rather than avoided. Many studies revealed that self-efficacy has positive implications for teaching and learning (Julaihi et al., 2020), as well as students' motivation (Margolis & MacCabe, 2003), students' confidence (Landrum, 2020), and students' academic performance (Adeyinka et al., 2011).

Self-efficacy has been identified as a critical aspect (Shen et al., 2013) and a critical factor (You & Kang, 2014) for successful online learning, as well as the critical predictor of Mathematics achievement and behaviour (Hoffman, 2010). The Organisation for Economic Co-operation and Development, OECD (2013) described Mathematics self-efficacy as one's belief in performing the mathematical task effectively and overcoming difficulties. According to Albelbisi and Yusop (2019), self-efficacy is vital for a successful online educational experience. Zimmerman and Kulikowich (2016) contended that students with high self-efficacy are more likely to become effective learners in an online environment. Numerous studies have reported students' self-efficacy according to gender, academic performance, prior learning experience, and comfort level. However, there are differences in the findings due to different contexts and approaches. Thus, this study contributes to expanding the students' self-efficacy on these four variables, particularly in Mathematics online learning.

i) Gender

Some studies reported that male students exhibited higher levels of self-efficacy than female students (Ochieng, 2015), some studies showed females performed better than their male counterparts (Fletcher, 2005), while some studies found no significant difference in the students' self-efficacy across gender (Yayuzalp & Bahcivan, 2020).

ii) Academic performance

Previous studies reported that students' self-efficacy and academic performance are positively correlated (Aldhahi et al., 2021; Chemers et al.,2001), where higher levels of self-efficacy are more likely to result in higher levels of academic performance or otherwise. Adeyinka et al. (2011) reported that students with low self-efficacy attribute the result to poor mathematical ability. Further and Dullas (2010) revealed that self-efficacy is a good predictor of academic performance in Mathematics and was validated by Akram and Ghazanfar (2014). In contrast, some studies found no significant relationship between students' self-efficacy and academic performance (e.g. Cho & Shen, 2013; Gębka, 2014).

iii) Prior online learning experience

Shen et al. (2013) suggested prior online learning experience to be related to students' self-efficacy, besides the above two variables. They reported that students with more prior online learning experiences are likely to have a higher level of self-efficacy.

iv) Comfort level

Ramsin and Mayall (2019) reported that the students' comfort level using the internet was significantly correlated to their online learning self-efficacy. They found that students who were better at using computers and more comfortable surfing the internet were likely to be more confident that they would do well in courses delivered online. Ngo and Eichelberger (2021) reported that students' self-efficacy was differed by their comfort levels in using technology. Despite having high levels of comfort using the technologies, students may still struggle with adapting to the online learning experience (Taipjutorus et al., 2012). Many reliable instruments were developed on students' self-efficacy, but only a few measured students' self-efficacy in online learning. Table 1 shows the brief information on some instruments often cited by other research.

Table 1. Instruments on Students' Self-Efficacy in online learning.

Name of Instrument	Authors (Year)	Cited	Number of Items	Likert Scale	Domain
Online Technologies Self-Efficacy Survey Scale (OTSES)	Miltiadou & Yu (2000)	120	30	4-point Likert: From "not confident" to "very confident"	(a) Internet Competencies, (b) Synchronous Interaction, (c) Asynchronous Interaction I, and (d) Asynchronous Interaction II.
The Self-Efficacy Questionnaire for Online Learning (SeQoL)	Shen et al. (2013)	132	35	11-point Likert: From "cannot do at all" to "highly confidence can do."	self-efficacy to: (a) complete an online course, (b) interact socially with classmates, (c) handle tools in a Course Management System (CMS), (d) interact with instructors in an online course, and (e) interact with classmates for academic purposes
Online Learning Self-Efficacy Scale (OLSES)	Zimmerman & Kulikowich (2016)	75	22	6-point Likert: from "strongly disagree" to "strongly agree."	self-efficacy for: (a) learning online, (b) time management, and (c) using technology

3 METHODOLOGY

This paper investigates undergraduate students' self-efficacy, particularly in Mathematics online learning. Quantitative data were collected via a google form survey to gather responses simply and efficiently.

The google form survey was divided into two sections. Table 2 shows the description of each section, number of items, domain, and the source where items were adapted. The Cumulative Grade Point Average (CGPA) of students' past grades was considered the academic performance variable. In contrast, the students' current semester of the study was considered as prior online learning experiences variable.

Section B of the study sought to obtain the respondents' feedback on their online learning self-efficacy in mathematics. The questionnaire from this section was adapted from Learning Self-Efficacy Scale (OLSES) developed by Zimmerman and Kulikowich (2016). This instrument was chosen as it was the latest among other related instruments (see Table 1) and has been widely used by other current studies on students' self-efficacy in online learning (Yavuzalp & Bahçivan, 2020; Stephen & Rockinson-Szapkiw, 2021; Aldhahi et al., 2021; Panergayo & Mansujeto, 2021). According to Yavuzalp and Bahçivan (2020), the up-to-date instrument was expected to provide more accurate results that conform to current conditions. Besides, the small number of items was also the reason for selection because of its practicability.

Table 2. Description of sections in google form survey.

Section	**Description**	**Num of Items**	**Domain**	**Adapted From**
A Profile	To generate the respondents' profile	4	Gender (1) Semester of study / Prior Online Learning Experience (1) Academic performance (CGPA) (1) Online learning comfort level (1)	Self-developed
B Online Learning Self-Efficacy Scale (OLSES)	To generate information on the respondents' self-efficacy in their learning of Mathematics online courses	19	Learning (7) Time management (5) Technology use (7)	Zimmerman & Kulikowich (2016)

Section B consisted of 19 items of OLSES (originally 22 items) and incorporated three domains, which are self-efficacy for (1) learning in an online environment; (2) time management; and (3) technology use. Three items from the original OLSES version were excluded from the survey. "Find the syllabus online" was deleted due to similarity with other items. Meanwhile, "Navigate the online grade book" and "Communicate effectively with technical support via email, telephone, or live online chat" were taken out as they are not required or relevant to Mathematics online courses that the respondents were enrolled in. This section was measured in a 5-point Likert scale: 1 – "Not at all confident", 2 – "Slightly confident", 3 – "Somewhat confident", 4 – "Fairly confident", and 5 – "Completely confident". A 5-point Likert was employed to minimise the frustration level of the respondents and hence increase the rate and quality of the responses

(Sachdev & Verma, 2004). The 5-point Likert scale, which reflects the level of confidence, was analysed based on the range of intervals shown in Table 3.

Table 3. The level of confidence for the 5-point Likert scale

Range of interval	Level of confidence
1.00 – 1.79	Not at all confident
1.80 – 2.59	Slightly confident
2.60 – 3.39	Somewhat confident
3.40 – 4.19	Fairly confident
4.20 – 5.00	Completely confident

The reliability of the domains in Section B was examined using Cronbach's Alpha. The alpha coefficient ranges in value from 0 to 1. As shown in Table 4, the reliability coefficients for the three domains ranged from 0.889 to 0.911, suggesting excellent internal consistency reliability for all domains.

Table 4. Cronbach's alpha of OLSES domains

Domain	Num of Items	N	Mean	SD	Cronbach's Alpha
OLSES Learning	7	343	3.0212	0.81457	0.911
OLSES Time Management	5	343	3.0933	0.83276	0.889
OLSES Technology Use	7	343	3.1612	0.77704	0.892

A pilot test was conducted on ten diploma students from a higher institution. The necessary modifications, changes, and corrections were done to ensure ease of understanding and clarification of all items in the questionnaire.

Three hundred forty-three undergraduate students in Sarawak, Malaysia, participated in this survey. The data were collected via a google form, which was disseminated in May 2021. Table 5 shows the demographic profiles of the respondents.

The data analysis included calculating descriptive statistics, such as percentage, frequency, mean and standard deviation, and the measure of inferential statistics, which comprised of Chi-Square Test, Pearson correlation, independent t-test, and One-way Analysis of Variance (ANOVA), and Post Hoc Tests. Chi-Square Test was used to analyse the students' self-efficacy across comfort levels. A Pearson correlation was performed to investigate the relationship between the three domains of students' self-efficacy. Meanwhile, to examine the variables that affect students' self-efficacy, an independent t-test and One-way Analysis of Variance (ANOVA) were carried out. Further analysis using Post Hoc Tests was performed to determine the mean difference between pairs of significant variables.

4 RESULTS AND DISCUSSION

Table 5 illustrates the profiles of the 343 undergraduate students who are the respondents of this study. 219 (63.8%) of the respondents are females, and the remaining 124 (36.2%) are males. All the respondents are Diploma students were. The majority (60.6%) are in semester 2 of study, 30.0% are in semester 1, and 9.4% are in semester three onwards. With regards to academic performance, only 206 respondents responded. 103 of them were semester one students who had yet to receive their Cumulative Grade Point Average (CGPA), whereas 34 students had no responses. Out of 206 respondents, 34.0% of them obtained a CGPA of 3.50 to 4.00, 34.0% obtained a CGPA of 3.00 to 3.49, 23.3% obtained a CGPA of 2.50 to 2.99, and 7.7% obtained a CGPA of below 2.50. In terms of comfort level, only 12.5% of the respondents were somewhat not comfortable, whereas 63.8% and 23.7% of them were respectively relatively comfortable and very comfortable with Mathematics online learning. None of the respondents rated not at all comfortable with Mathematics online learning.

Table 5. Profiles of the respondents.

Profiles	**Total**
Gender (n=343)	
Female	219 (63.8%)
Male	124 (36.2%)
Semester of study / Prior Learning Online Experience (n=343)	
Sem 1	103 (30.0%)
Sem 2	208 (60.6%)
Sem 3	3 (1.0%)
Sem 4	22 (6.4%)
Sem 5 and above	7 (2.0%)
Academic performance (CGPA) (n=206)	
1.99 and below	4 (1.9%)
2.00 to 2.49	12 (5.8%)
2.50 to 2.99	48 (23.3%)
3.00 to 3.49	70 (34.0%)
3.50 to 4.00	72 (35.0%)
Comfort level (n=343)	
Not at all comfortable	0 (0.0%)
Somewhat not comfortable	43 (12.5%)
Somewhat comfortable	219 (63.8%)
Very comfortable	81 (23.7%)

Table 6 shows the overall results of the students' level of self-efficacy across gender, semester of study, academic performance, and comfort level, respectively. Three ranges of total scores were used to indicate whether the respondent has low self-efficacy (19 – 44), moderate self-efficacy (45 – 69), or high self-efficacy (70 – 95) for all domains. The ranges are determined based on an equal division of the three self-efficacy levels between the minimum scores (19 items' 1-point Likert =

19) and the maximum scores (19 items' 5-point Likert = 95). The results revealed that 61 out of 343 respondents (17.8%) have low self-efficacy. Meanwhile, 199 respondents (58.0%) have moderate self-efficacy, and 83 respondents (24.2%) have high self-efficacy. As seen in Table 6, most respondents with moderate (173 respondents or 86.9%) and high (83 respondents or 95.2%) self-efficacy were "somewhat comfortable" and "very comfortable" with learning Mathematics online.

Table 6. Students' level of self-efficacy compared with respondents' demographic profiles.

Demographic profiles	**Level of Self-Efficacy**			**Total**
	Low	Moderate	High	
Gender (n=343)				
Female	41	124	54	219
Male	20	75	29	124
Total	**61**	**199**	**83**	**343**
(Percentage)	**(17.8%)**	**(58.0%)**	**(24.2%)**	
Semester of study (n=343)				
Semester 1	24	61	18	103
Semester 2	35	118	55	208
Semester 3	0	3	0	3
Semester 4	1	13	8	22
Semester 5 and above	1	4	2	7
Total	**61**	**199**	**83**	**343**
(Percentage)	**(17.8%)**	**(58.0%)**	**(24.2%)**	
Academic performance (CGPA) (n=206)				
1.99 and below	2	1	1	4
2.00 to 2.49	4	6	2	12
2.50 to 2.99	7	29	12	48
3.00 to 3.49	9	46	15	70
3.50 to 4.00	12	36	24	72
Total	**34**	**118**	**54**	**206**
(Percentage)	**(16.5%)**	**(57.3%)**	**(26.2%)**	
Comfort level (n=343)				
Not at all comfortable	0	0	0	0
Somewhat not comfortable	13	26	4	43
Somewhat comfortable	41	136	42	219
Very comfortable	7	37	37	81
Total	**61**	**199**	**83**	**343**
(Percentage)	**(17.8%)**	**(58.0%)**	**(24.2%)**	

As seen in Table 7, The Chi-Square result showed a significant relationship between students' self-efficacy and comfort levels.

Table 7. Analysis of students' self-efficacy across comfort levels – Chi-Square Tests.

	Value	**df**	**Sig.**	**Conclusion**
Pearson Chi-Square	32.130	4	.000	significant difference
Likelihood Ratio	30.694	4	.000	significant difference
Linear by Linear Association	26.767	1	.000	significant difference
N of Valid Cases	343			

The following three tables present the findings of 343 students on their self-efficacy to learn in an online environment (Table 8), time management (Table 9), and technology use (Table 10) in the context of learning Mathematics online. The overall results show that the students' self-efficacy for all the three domains is at the level range of "somewhat confident" (2.60 – 3.39): online environment (*M*=3.02, *SD*=0.815); time management (*M*=3.07, *SD*=0.833); technology use (*M*=3.16, *SD*=0.777).

As shown in Table 8, the highest mean score for the domain' online environment' was conquered by the item "Learn to use new technologies in MAT learning efficiently" (*M*=3.22, *SD*=0.915). On the other hand, "Learn MAT without being in the same room as my lecturer" (*M*=2.83, *SD*=1.056) and "Learn MAT without being in the same room as other students" (*M*=2.82, *SD*=1.084) were the two lowest items ranked by the respondents. The results indicate that students need lecturers and friends to guide and motivate them in Mathematics learning.

Table 8. Students' reported self-efficacy in the learning environment.

Items	**5-Point Likert Scale**					**Mean**	**SD**
	Not At All Confident	Slightly Confident	Somewhat Confident	Fairly Confident	Completely Confident		
Overcome technical difficulties during my MAT learning on my own	26 (7.6%)	79 (23.0%)	135 (39.4%)	85 (24.8%)	18 (5.2%)	2.97	0.997
Learn to use new technologies in MAT learning efficiently	11 (3.2%)	57 (16.6%)	146 (42.6%)	105 (30.6%)	24 (7.0%)	3.22	0.915
Learn MAT without being in the same room as my lecturer	42 (12.2%)	81 (23.6%)	129 (37.6%)	74 (21.6%)	17 (5.0%)	2.83	1.056
Learn MAT without being in the same room as other students	45 (13.1%)	85 (24.8%)	114 (33.2%)	83 (24.2%)	16 (4.7%)	2.82	1.084
Communicate using asynchronous technologies (different time - e.g., online chatting)	19 (5.5%)	63 (18.4%)	122 (35.6%)	108 (31.5%)	31 (9.0%)	3.20	1.022

Communicate using synchronous technologies (same time - e.g., video conferencing)	22 (6.4%)	65 (19.0%)	133 (38.8%)	104 (30.3%)	19 (5.5%)	3.10	0.982
Promptly ask questions related to MAT via appropriate forum (online chat etc)	22 (6.4%)	85 (24.8%)	125 (36.4%)	91 (26.5%)	20 (5.8%)	3.01	1.003
Total	**187 (7.8%)**	**515 (21.4%)**	**904 (37.7%)**	**650 (27.1%)**	**145 (6.0%)**	**3.02**	**0.815**

*SD: Standard Deviation; MAT: Mathematics

Table 9 illustrates that the highest mean score for the domain' time management' was conquered by the item "Meet deadlines with few reminders" (*M*=3.24, *SD*=0.933), and the lowest mean score was conquered by the item "Focus on my MAT chores when faced with distractions" (*M*=2.92, *SD*=0.964). It can be inferred that students may not concentrate when studying if they are distracted entirely. However, with minimal monitoring by the lecturer, they can still submit their assignments on time.

Table 9. Descriptive statistics of students' self-efficacy on time management.

Items	**5-Point Likert Scale**					**Mean**	**SD**
	Not At All Confident	Slightly Confident	Somewhat Confident	Fairly Confident	Completely Confident		
Manage my time effectively	26 (7.6%)	85 (24.8%)	120 (35.0%)	97 (28.3%)	15 (4.4%)	2.97	1.005
Complete all MAT assignment on-time	23 (6.7%)	75 (21.9%)	106 (30.9%)	118 (34.4%)	21 (6.1%)	3.11	1.032
Focus on my MAT chores when faced with distractions	25 (7.3%)	86 (25.1%)	137 (39.9%)	82 (23.9%)	13 (3.8%)	2.92	0.964
Meet deadlines with very few reminders	13 (3.8%)	66 (19.2%)	120 (35.0%)	112 (32.7%)	32 (9.3%)	3.24	0.993
Develop and follow a plan for completing all required MAT tasks on-time	12 (3.5%)	76 (22.2%)	112 (32.7%)	111 (32.4%)	32 (9.3%)	3.22	1.007
Total	**99 (5.8%)**	**388 (22.6%)**	**595 (34.7%)**	**520 (30.3%)**	**113 (6.6%)**	**3.09**	**0.833**

*SD: Standard Deviation; MAT: Mathematics

As presented in Table 10, the highest mean score for the domain' technology use' was obtained by the item "Submit my MAT assignment via online platform successfully" (*M*=3.59, *SD*=0.986), followed by "Search the online MAT materials" (*M*=3.36, *SD*=1.055). However, there was no significant difference in the mean scores obtained by all items. The results indicate that the students do not have any problems submitting their Mathematics assignments using the online platform and searching the online learning materials. However, students are having problems using the library's online resources efficiently (*M*=2.74, *SD*=0.972). It may be due to less information on accessing and utilising the resources. Most respondents rated at least "somewhat confident" for each item in all domains, indicating that they have a moderate to high self-efficacy in learning Mathematics online.

Table 10. Descriptive statistics of students' self-efficacy on technology use.

Items	**5-Point Likert Scale**					**Mean**	**SD**
	Not At All Confident	Slightly Confident	Somewhat Confident	Fairly Confident	Completely Confident		
Navigate my MAT materials efficiently	16 (4.7%)	79 (23.0%)	147 (42.9%)	90 (26.2%)	11 (3.2%)	3.00	0.900
Communicate effectively with my MAT lecturer via social media	23 (6.7%)	83 (24.2%)	122 (35.6%)	89 (25.9%)	26 (7.6%)	3.03	1.037
Search the online MAT materials	16 (4.7%)	58 (16.9%)	102 (29.7%)	122 (35.6%)	45 (13.1%)	3.36	1.055
Search the online answer to my MAT questions/ problems	23 (6.7%)	70 (20.4%)	124 (36.2%)	93 (27.1%)	33 (9.6%)	3.13	1.056
Complete my MAT individual/ group assignment entirely online	12 (3.5%)	61 (17.8%)	121 (35.3%)	120 (35.0%)	29 (8.5%)	3.27	0.967
Submit my MAT assignment via online platform successfully	6 (1.7%)	44 (12.8%)	96 (28.0%)	134 (39.1%)	63 (18.4%)	3.59	0.986
Use the library's online resources efficiently	35 (10.2%)	99 (28.9%)	141 (41.1%)	55 (16.0%)	13 (3.8%)	2.74	0.972
Total	**131 (5.5%)**	**494 (20.6%)**	**853 (35.5%)**	**703 (29.2%)**	**220 (9.2%)**	**3.16**	**0.777**

*SD: Standard Deviation; MAT: Mathematics

Table 11 shows that there was a strong positive significant relationship between students' mean score of self-efficacy for all the three domains: mean score between online environment and time management ($r = 0.844$; $p < 0.05$); mean score between online environment and technology use ($r = 0.896$; $p < 0.05$); mean score between time management and technology use ($r = 0.871$; $p < 0.05$).

Table 11. Correlations between domains of students' self-efficacy.

		Mean_online environment	**Mean_time management**	**Mean_ technology**
Mean_online environment	Pearson Correlation	1	0.844**	0.896**
	Sig. (2-tailed)	0.000	0.000	0.000
	N	343	343	343
Mean_time management	Pearson Correlation	0.844**	1	0.871**
	Sig. (2-tailed)	0.000	0.000	0.000
	N	343	343	343
Mean_ technology	Pearson Correlation	0.896**	0.871**	1
	Sig. (2-tailed)	0.000	0.000	0.000
	N	343	343	343

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

Table 12 presents the analysis of students' self-efficacy in Mathematics online learning across gender. The mean efficacy value for male students was 3.07 (*SD* = 0.67885; *n* = 124) whereas the mean efficacy value for female students was 3.02 (*SD* = 0.77395; *n* = 219). Both groups did not differ much in their self-efficacy in Mathematics online learning.

Table 12. Analysis of students' self-efficacy across gender.

Gender	**N**	**Mean**	**SD**	**Levene's Test (Equality of Variances)**	**Independent t-test (Equality of Means)**	**Conclusion**
Male	124	3.0717	0.67885	0.044	0.548	No significance difference
Female	219	3.0234	0.77395			

Levene's Test for Equality of Variances shows that the variances between male and female students were not equal ($p<0.05$). Based on the Independent t-test output, there was no significant difference in students' self-efficacy in Mathematics online learning between genders ($p>0.05$). The finding indicates that gender does not affect the students' self-efficacy. It was consistent with Yayuzalp and Bahcivan's (2020) study, which reported no significant difference in self-efficacy between gender. According to Aldhahi et al. (2021), gender was not a predictor of technology self-efficacy.

One-way Analysis of Variance (ANOVA) was performed to assess the mean scores for students' self-efficacy in Mathematics online learning across their academic performance, online learning prior experience, and online learning comfort level. As shown in Table 13, the result revealed no significant difference in the mean scores of students' self-efficacy between groups of academic performance and online learning prior experience. No significant difference between groups of prior experience may be due to most respondents (90.6%) being in semesters 1 and 2 of the study. They were still new to the online learning environment.

Table 13. Analysis of students' self-efficacy across academic performance, prior experience and comfort level – One-way ANOVA.

Variable	N	F	Sig.	Conclusion
Academic Performance	206*	2.363	0.054	no significant difference
Prior Experience	343	1.265	0.284	no significant difference
Comfort Level	343	16.033	0.000	significant difference

*Excluded 137 students (CGPA information was not provided)

According to Panergayo and Mansujeto (2021), students' prior experience does not necessarily reflect their online self-efficacy. Regarding academic performance, although descriptive statistics indicate that students who obtained higher CGPA were more likely to achieve higher self-efficacy, there was no significant difference between groups of academic performance. The finding was supported by Flores (2020), which reported that the result attributed to the fact that students felt that they did not need to have a high academic performance to comply with the demands of academic requirements in the new norm of education.

Nevertheless, there was a significant difference in the mean scores of students' self-efficacy across their comfort levels in Mathematics online learning. Since the F-test showed a statistically significant difference in the mean scores between the groups of comfort level, the pairwise comparison of the mean scores using Post Hoc Tests was performed. As shown in Table 14, the analysis found two significant comparisons: (1) between somewhat not comfortable and very comfortable, and (2) between somewhat comfortable and very comfortable. In other words, students who were very comfortable significantly had higher self-efficacy than those who were somewhat not comfortable to somewhat comfortable. The finding was consistent with Ngo and Eichelberger (2021). They reported that students with high comfort levels were more self-efficacious in their learning than those with an average or low comfort level.

Table 14. Analysis of students' self-efficacy between groups of comfort level – One-Way ANOVA with Post Hoc Tests.

Comfort Level	N	Comfort Level	Sig.
Somewhat not comfortable	43	Somewhat comfortable	0.028
		Very comfortable	0.000
Somewhat comfortable	219	Somewhat not comfortable	0.028
		Very comfortable	0.000
Very comfortable	81	Somewhat not comfortable	0.000
		Somewhat comfortable	0.000
Total	343		

5 CONCLUSION

This study has added value to students' self-efficacy in Mathematics online learning. The results indicated that the students have moderate to high levels of self-efficacy, where most of them were

comfortable with the Mathematics online learning. In specific, there was a strong positive significant relationship between students' mean score of self-efficacy and the three domains, i.e., learning in an online environment, time management, and technology use. This study has also shown no significant difference in the mean scores of students' self-efficacy concerning gender, academic performance, and online learning prior experience. However, there was a considerable difference in the mean scores of students' self-efficacy across online learning comfort levels. It was noticed that students with higher self-efficacy were more comfortable with online learning.

There are certain limitations to this study that should be mentioned. This study's results may be influenced because it included respondents from various backgrounds. Furthermore, most of the responders were first-year and second-year students for whom online learning was a novel experience. In addition, the study's scope was limited to public universities. As a result, future studies should include students from private institutions and compare their self-efficacy to students from public universities. Future research also could continually study the students' self-efficacy in online learning and the implication to the students' academic accomplishment. Multiple linear regression could analyse academic success across self-efficacy dimensions for more detailed and meaningful results in the analysis section. It is also recommended that future research should consider involving a larger sample size to yield more reliable results with greater precision.

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