



# The Relationship between Self-Regulated Online Learning and Student Attitudes toward Learning Mathematics as Mediated by Internet and Social Networking Experience

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**Abstract:** This study investigated the relationship between self-regulated online learning and students' attitudes toward learning mathematics, with a specific focus on the mediating role of internet and social networking experiences among public Junior and Senior high school students. The research measured levels of self-regulated learning, attitudes toward mathematics, and digital engagement using structured questionnaires. Results indicated that students demonstrated high levels of metacognitive skills, effective time management, persistence, and positive attitudes, including confidence, enjoyment, and perceived usefulness of mathematics. Correlation and regression analyses revealed a significant positive relationship between self-regulated online learning and student attitudes toward mathematics. Moreover, internet and social networking experiences were found to mediate this relationship significantly. The mediation analysis showed that 26.04% of the total effect was indirect, suggesting partial mediation. This means that while self-regulated learning directly influences students' mathematical attitudes, internet and social networking experiences also enhance this effect. Therefore, both self-regulation and digital engagement play essential roles in shaping students' attitudes toward learning mathematics. These findings underscore the importance of promoting effective online learning strategies and responsible use of digital platforms to foster academic engagement and positive learning outcomes in mathematics, particularly in the context of increasing reliance on digital education.

**Keywords:** self-regulated learning, student attitude, internet use, social networking

## 1. INTRODUCTION

### 1.1. Rationale

The vital role of mathematics in society is indisputable, as it equips students with essential skills to address both academic and real-world challenges (Smith et al., 2022). Its significance is reflected in its prominent place in educational curricula, particularly in basic education (Zamir, Zhang, Wenwu, & Sarwar, 2022). Despite this emphasis, international assessments consistently highlight students' difficulties in achieving mathematical proficiency (Ina, Mullis, Martin, Foy, & Kelly, 2019). These persistent struggles underscore the need for a more in-depth examination of the factors that influence students' attitudes toward learning mathematics. Specifically, issues such as math anxiety, lack of motivation, and negative perceptions of the subject contribute to disinterest and poor performance. Moreover, the evolving digital landscape introduces new dimensions, with students' experiences in self-regulated online learning and social networking shaping their attitudes and engagement with mathematics. Understanding these factors is critical for developing effective pedagogical strategies that foster positive attitudes and enhance mathematical learning outcomes.

Research has pinpointed students' attitudes toward mathematics as a pivotal factor influencing their mathematical performance (Turgut, 2022; Vidic, Klasnic, & Duranovic, 2022). Positive attitudes toward mathematics have been linked with enhanced problem-solving competencies (Zamir et al., 2022), effective learning strategies (Vidic et al., 2022), and autonomous learning behaviors (Leon-Mantero et al., 2020). Conversely, negative emotions and beliefs regarding mathematics can hinder students' performance (Vidic et al., 2022; Leon-Mantero et al., 2020).

Self-regulated learning stands out as a crucial pedagogical principle in education, particularly for its correlation with students' achievement in mathematics and beyond the classroom (Putri, Muqodas, Sasqia, Abdulloh, & Yuliyanto, 2020; Putri, Sasqia, Abdulloh, Fuada, Muqodas, & Majid, 2021).

Nonetheless, recent studies indicate that students encounter challenges in managing their task engagements, lifestyle, and time spent on the internet and social networking platforms (Putri et al., 2020; Kusuma et al., 2021). These challenges often lead to poor performance in mathematics, particularly in the context of hybrid, flexible, modular, and online learning modes (Putri et al., 2021; Kusuma et al., 2021).

## **2. RESEARCH OBJECTIVES**

The primary objective of this study is to explore the mediating effect of internet and social networking experiences on the relationship between self-regulated online learning and students' attitudes toward mathematics. Specifically, it aims to:

1. Describe the level of students' self-regulated online learning in terms of:
  - 1.1 metacognitive skills,
  - 1.2 time management,
  - 1.3 environmental structuring,
  - 1.4 persistence, and
  - 1.5 help-seeking.
2. Ascertain the level of students' attitudes toward mathematics in terms of:
  - 2.1 checking solutions,
  - 2.2 confidence,
  - 2.3 enjoyment,
  - 2.4 multiple solutions, and
  - 2.5 usefulness of mathematics.
3. Measure the level of students' internet and social networking experience in terms of:
  - 3.1 intrapersonal and
  - 3.2 interpersonal conflicts.
4. Determine the significance of the relationships among the following:
  - 4.1 self-regulated online learning,
  - 4.2 attitudes toward mathematics, and
  - 4.3 internet and social networking experience.
5. Determine the significance of the mediating effect of internet and social networking experience on the relationship between self-regulated online learning and students' attitudes toward mathematics.

## **3. HYPOTHESES**

The following tested were 0.05 level of significance:

1. There is no significant relationship between:
  - 1.1 self-regulated online learning and student attitudes toward learning mathematics.
  - 1.2 self-regulated online learning and internet and social networking experience.
  - 1.3 internet and social networking experience and student attitudes toward learning mathematics.
2. The Internet and social networking experience does not significantly mediate the relationship between self-regulated online learning and student attitudes toward learning mathematics.

## **4. THEORETICAL FRAMEWORK**

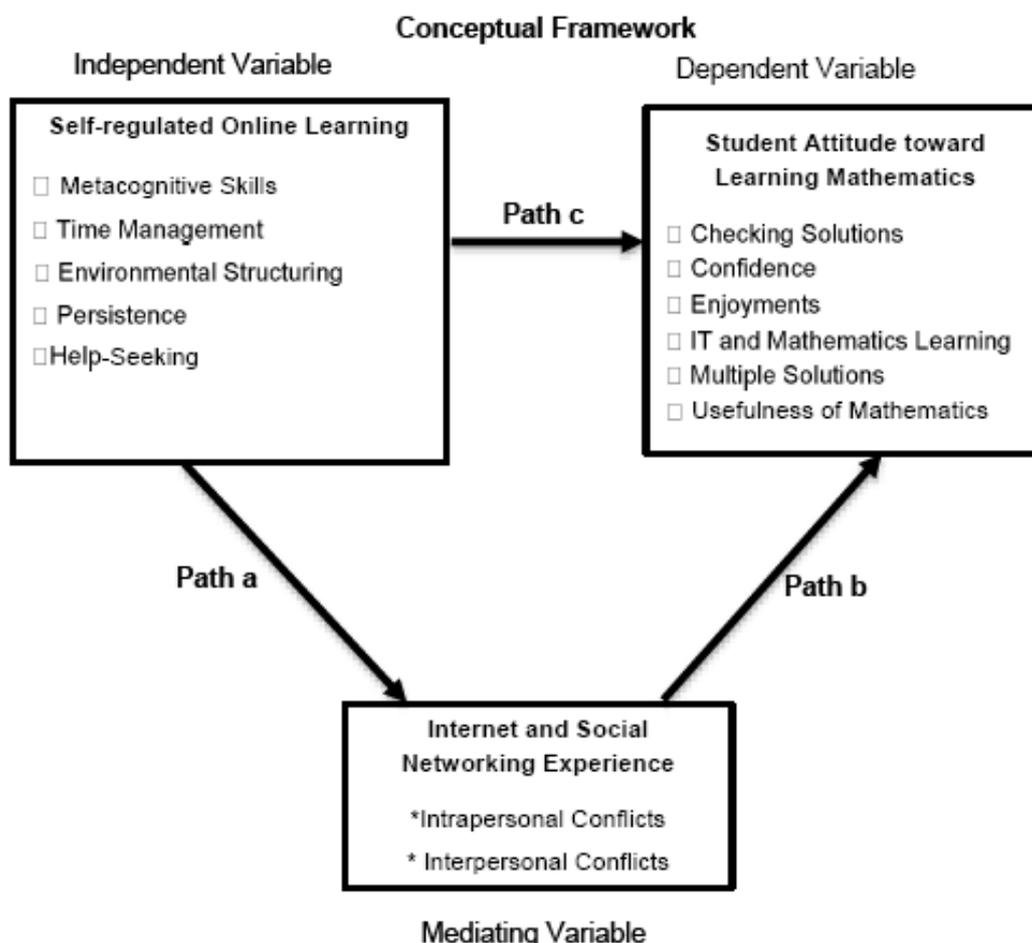
This study is anchored on four foundational theories that collectively explain the relationship among self-regulated online learning, internet and social networking experience, and student attitudes toward learning mathematics.

First, the Individualized Instruction Theory by Kemp and Smellie (1989) supports the idea that instruction should be tailored to the unique needs of learners. In the context of this study, it justifies the use of flexible and modular learning approaches that empower students to take control of their educational experiences. This theory aligns with the shift toward digital and online learning environments, where personalized pacing and content delivery are emphasized. Second, Zimmerman's Self-Regulated Learning Theory (1989) provides the theoretical foundation for the independent variable—self-regulated online learning. This theory posits that learners actively manage their learning through goal setting, self-monitoring, and strategic action. It emphasizes metacognitive processes and

motivational control, both of which are crucial for academic success in online learning environments. The theory explains how students who exhibit strong self-regulation skills are more likely to succeed academically. Third, the study draws upon Bandura's Social Cognitive Theory (1986), which highlights the reciprocal interaction among personal factors, behavior, and environmental influences. This theory supports the inclusion of internet and social networking experience as a mediating variable, recognizing that digital environments significantly shape learners' attitudes and behaviors. The social interactions and content students are exposed to online influence their academic motivation, confidence, and perception of mathematics. Lastly, the Interest Development Theory by Hidi and Renninger (2006) is integrated to explain how situational interest—often triggered by interactive and engaging online learning experiences—can evolve into sustained personal interest. This theory underscores the importance of relevance and enjoyment in learning, particularly in mathematics, where engagement is critical to attitude formation. Together, these theories offer a comprehensive lens for understanding how self-regulated online learning and digital experiences interact to influence students' attitudes toward learning mathematics.

**5. CONCEPTUAL FRAMEWORK**

The conceptual framework of this study is grounded in the Individualized Instruction Theory, as proposed by Kemp and Smellie (1989), which emphasizes tailoring learning experiences to meet students' individual needs through modular instruction. This framework illustrates the indirect influence of self-regulated online learning on student attitudes towards mathematics, as mediated by internet and social networking experiences. In this model, student attitudes towards mathematics serve as the dependent variable, characterized by indicators such as solution-checking behaviors, confidence, enjoyment, IT and mathematics integration, multiple solution approaches, and the perceived usefulness of mathematics. On the other hand, self-regulated online learning functions as the independent variable, encompassing skills such as goal setting, time management, environmental structuring, persistence, and help-seeking.



**Figure 1.** *Conceptual paradigm of the study*

## **6. SIGNIFICANCE OF THE STUDY**

The significance of this study extends both globally, contributing to the existing literature, and socially, benefiting humanity and the community. Specifically, this study will provide valuable insights for educators, policymakers, and educational institutions to enhance the quality of mathematics education, particularly in the context of online and flexible learning modes. Future researchers will also benefit from the insights and findings of this study, which will guide them in exploring the intricate relationships among self-regulated learning, attitudes toward mathematics, and internet and social networking experiences.

### **6.1. Definition of Terms**

To ensure clarity, the following terms are defined as they are used within the context of this study:

**Self-Regulated Online Learning** - Refers to students' ability to actively manage and control their learning in an online environment.

**Student Attitude Toward Learning Mathematics** - Denotes students' feelings, beliefs, and dispositions toward mathematics as a subject. This study measures attitude.

**Internet and Social Networking Experience** - Refers to students' frequency, manner, and emotional experiences while using internet and social networking platforms.

## **7. METHOD**

### **7.1 Research Design**

The study employed a quantitative, non-experimental research design using a correlational technique to gather data, facts, and information related to the research variables. According to Bhandari (2021), quantitative research focuses on the quantification of data collection and analysis, adopting a deductive approach that emphasizes testing theories through empirical evidence. This design aligns with empiricist and positivist philosophies, which prioritize objective measurements and observable phenomena. Non-experimental research, by definition, does not involve manipulating an independent variable. Instead, it observes and measures variables as they naturally occur in real-world settings (Creswell & Creswell, 2018). This approach was appropriate for the study, as it aims to assess the relationships between self-regulated online learning, attitudes toward mathematics, and internet and social networking experiences without altering the conditions under which these variables exist.

### **7.2 Research Locale**

The study was conducted in four public secondary schools located in Caraga, Davao Oriental, Philippines. These schools include San Luis National High School, Caraga National High School, Pantuyan National High School, and Santiago National High School. The selected schools were chosen due to their accessibility and relevance to the focus of the study, particularly their implementation of modular and online flexible learning modalities during and after the COVID-19 pandemic. These schools provided an ideal setting for examining students' self-regulated online learning behaviors, their experiences with internet and social networking platforms, and their attitudes toward learning mathematics in a blended educational environment. The research locale represents a typical provincial context in the Philippines, where challenges and innovations in online education continue to evolve.



### **7.3 Population and Sample**

The population of the study comprised junior and senior high school students from four public secondary schools in Caraga, Davao Oriental, Philippines, namely San Luis National High School, Caraga National High School, Pantuyan National High School, and Santiago National High School. A total of 300 students were selected as respondents for the study. The sample size was determined using Slovin's formula, which ensures a representative sample size from a known population while maintaining a 5% margin of error and a 95% confidence level. To enhance the representativeness of the sample, a stratified random sampling technique was employed. This involved grouping students according to grade levels (Grades 7 to 12) and then randomly selecting respondents from each group to ensure equal representation. The inclusion criteria for the study required that students be officially enrolled during the 2024–2025 academic year and capable of answering the survey questionnaires. Students who were not enrolled in the current academic year or who belonged to schools outside the identified research locale were excluded from participation. This sampling approach ensured diversity in responses and increased the generalizability of the study findings across the different grade levels within the selected schools.

## **8. RESEARCH INSTRUMENT**

The study will utilize three standardized questionnaires: the Learning Mathematics Questionnaire – Adapted from Chen, Q. and Wong, K.Y. (2012); Online Learning Modality Questionnaire – Adapted from Jansen, R.S. et al. (2016); Internet and Social Networking Questionnaire – Adapted from Casas, J. et al., (2013). Each questionnaire employed a five-point Likert scale to measure the variables.

The questionnaires were subjected to content validity and reliability analysis to ensure the accuracy of the measurements. External experts with expertise in research and statistics validated the survey instruments.

To ensure the accuracy, consistency, and validity of the research instruments, the study will undergo content validation and reliability testing. The survey questionnaires were subjected to content validation by three external experts with expertise in educational research and statistics. The validators will assess the relevance, clarity, and appropriateness of the questionnaire items in measuring the intended constructs: self-regulated online learning, internet and social networking experiences, and attitudes toward mathematics. Their feedback was used to refine and improve the survey items, ensuring that they accurately capture the variables under investigation.

## **9. DATA COLLECTION**

Prior to data collection, the researcher will seek permission from the Dean of Professional Schools and the Schools Division Superintendent of the Department of Education in Davao Oriental. Upon approval, the researcher will visit the schools to discuss the research plan with the school heads and request a list of student-athletes. The list will serve as the basis for selecting the respondents. The data collection period was specified, followed by the encoding, tallying, validation, analysis, and interpretation of the collected data.

**Sobel z-test** to determine the mediating effect of internet and social networking experience on the relationship between self-regulated online learning and attitude towards Mathematics.

## **10. ETHICAL CONSIDERATION**

The study will adhere to the principles of ethical research to protect the rights and welfare of participants.

**Voluntary Participation:** The researcher will ensure that participation in the study is entirely voluntary by clearly informing all potential respondents—both students and their parents or guardians—that they are free to decline or withdraw from the research at any point without any consequences.

**Privacy and Confidentiality:** The researcher will strictly protect the privacy and confidentiality of all participants in compliance with the Data Privacy Act of 2012. All data collected will be treated with the highest level of confidentiality, and identifying information will not be disclosed to anyone not directly involved in the study.

**Informed Consent Process:** Prior to the administration of the questionnaires, the researcher will obtain informed consent from the respondents and will clearly explain the nature and purpose of the study, including all pertinent details necessary for their informed decision to participate.

**Recruitment:** The researcher will implement a clear and systematic recruitment strategy aligned with the objectives of the research, which focuses on junior and senior high school students' self-regulated online learning and attitudes toward mathematics.

**Risks:** The researcher recognizes that participation in the study may involve minimal risks to the respondents. These include potential emotional discomfort that may arise when students reflect on their attitudes toward mathematics, online learning experiences, or internet usage. Some participants may also experience survey fatigue due to the time required to complete the questionnaire.

**Benefits:** One of the main benefits of the study is the potential to yield generalizable knowledge about the respondents' condition related to the self-regulated online learning and attitude toward learning mathematics.

**Plagiarism:** In this study, plagiarism or the use of another person's ideas, processes, results, or words without giving appropriate credit will be addressed through citing or giving credit to the work of others, whether published or unpublished, and whether it had been a written work, an oral presentation, or material on a website. Each and every in-text citation is reflected in the Reference section.

**Fabrication:** To address fabrication, which is the making up of data or results and recording or reporting them, the researcher will obligate his/herself to maintain a clear and complete record of data acquired in order to preserve accurate documentation of observed facts with which later reports or conclusions can be compared.

**Falsification:** Falsification will also be avoided by making sure that the research materials or processes used are true and correct. There will be no changing or omitting of data or results such that the research is not accurately represented in the research record.

**Conflict of Interest (COI):** The researcher affirms that there are no actual or potential conflicts of interest that could influence the conduct, findings, or reporting of this study. No financial, institutional, or personal support has been received from any organization or individual with a vested interest in the outcomes of this research.

**Deceit:** Any deception, deceit, or exaggeration about the aims and objectives of the research will be avoided.

**Permission from Organization/Location:** The researcher will write a letter of request to conduct the study. The copy of the research proposal and the questionnaires shall also be enclosed so that the said authorities would get an idea of the importance of this study to their department or school.

**Authorship:** The researcher will make a significant contribution to the idea and design, data gathering, or data analysis and interpretation with the support and guidance of the research adviser. The research will be written cooperatively by the researcher and adviser, and it will be critically revised for essential intellectual substance.

## **11. RESULTS**

### **11.1. Level of self-regulated online learning mathematics of the students**

The data in Table 1 shows that students demonstrated a high level of self-regulated learning in online mathematics, with an overall mean of 3.91 and a relatively low standard deviation of 0.26, indicating consistent responses across participants. All five indicators are rated at a high descriptive level, with Environment Structuring and Help-Seeking tied for the highest mean of 3.94, suggesting that students are effective at organizing their learning spaces and seeking assistance. Meanwhile, Time Management and Persistence had the lowest means at 3.90, albeit still within the high category, which may point to areas where students experience slightly more difficulty. Among all indicators, Time Management shows the most significant variability ( $SD = 0.66$ ), indicating differences in students' ability to manage their schedules.

**Table 1.** Level of self-regulated online learning mathematics of the students

Indicators	Mean	SD	Descriptive Level
Metacognitive skills	3.91	0.32	High
Time management	3.90	0.66	High
Environment structuring	3.94	0.55	High
Persistence	3.90	0.62	High
Help-seeking	3.94	0.52	High
<b>Overall</b>	<b>3.91</b>	<b>0.26</b>	<b>High</b>

### 11.2. Level of students' attitude toward learning mathematics

Table 2 reflects a generally positive student attitude toward learning mathematics, with an overall mean of 3.95 and a standard deviation of 0.42, showing relatively uniform perceptions. All indicators fall under the high descriptive level, with IT and Mathematics Learning scoring the highest mean (4.02), indicating a strong appreciation for technology-enhanced learning. In contrast, Enjoyment had the lowest mean (3.91), which, while still high, suggests a slightly lower emotional engagement compared to other aspects, such as confidence or perceived usefulness. The highest standard deviation is also found in Enjoyment (SD = 0.74), revealing greater variability in how students emotionally experience mathematics.

**Table 2.** Level of students' attitude toward learning mathematics

Indicators	Mean	SD	Descriptive Level
Checking Solutions	3.94	0.56	High
Confidence	3.92	0.57	High
Enjoyment	3.91	0.74	High
IT and Mathematics Learning	4.02	0.69	High
Multiple Solutions	3.98	0.65	High
Usefulness of Mathematics	3.96	0.60	High
<b>Overall</b>	<b>3.95</b>	<b>0.42</b>	<b>High</b>

### 11.3. Level of internet and social network experience of the students

Table 3 shows that students exhibit a high level of internet and social network experience, with an overall mean of 3.79 and a standard deviation of 0.48. Among the indicators, Interpersonal Conflicts recorded the highest mean (3.99), followed closely by Intrapersonal Conflicts (3.97), suggesting that while students are highly active online, their engagement sometimes leads to social or personal challenges. The higher standard deviation for Interpersonal Conflicts (SD = 0.75) indicates that students vary more widely in their experiences of online social interactions.

**Table 3.** Level of internet and social network experience of the students

Indicators	Mean	SD	Descriptive Level
Intrapersonal conflicts	3.97	0.61	High
Interpersonal conflicts	3.99	0.75	High
<b>Overall</b>	<b>3.79</b>	<b>0.48</b>	<b>High</b>

### 11.4. Correlation Matrix on the Relationship between Self-regulated Online Learning and students' Attitude toward Learning Mathematics

Table 4.1 shows mostly positive and statistically significant correlations between components of self-regulated learning and various aspects of students' attitudes toward mathematics. The strongest relationships are observed between Persistence and IT and Mathematics Learning ( $r = 0.597, p < .001$ ) and between Help Seeking and Multiple Solutions ( $r = 0.559, p < .001$ ), indicating that students who persist and seek Help tend to view mathematics more favorably and recognize multiple problem-solving strategies. Overall, the total self-regulated learning score is significantly correlated with all attitude indicators (e.g.,  $r = 0.366, p < .001$ ), confirming a moderate, positive relationship.

**Table 4.1.** Correlation Matrix on the Relationship between Self-regulated Online Learning and students' Attitude toward Learning Mathematics

Student attitude toward learning Mathematics	Self-regulated Online Learning					Overall
	Meta-cognitive skills	Time Management	Environmental Structuring	Persistence	Help-Seeking	
Checking Solution	-0.063 (.280)	0.062 (.283)	-0.001 (.983)	0.053 (.362)	0.125* (0.030)	0.027 (.644)
Confidence	-0.016	0.088	0.191*	0.192*	0.131*	0.168*

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	(.786)	(.129)	(.001)	(.001)	(.023)	(.004)
Enjoyment	-0.052 (.370)	0.166* (.004)	0.271* (.000)	0.310* (.000)	0.258* (.000)	0.261* (.000)
IT and Mathematical Learning	-0.079 (.171)	0.116* (.044)	0.362* (.000)	0.597* (.000)	0.258* (.000)	0.324* (.000)
Multiple Solutions	-0.086 (.139)	0.196* (.001)	0.284* (.000)	0.320* (.000)	0.559* (.000)	0.339* (.000)
Usefulness of Mathematics	-0.069 (.232)	0.056 (.331)	0.218* (.000)	0.357* (.000)	0.306* (.000)	0.240* (.000)
<b>Overall</b>	-0.092 (.110)	0.177* (.002)	0.345* (.000)	0.474* (.000)	0.436* (.000)	<b>0.366*</b> (.000)

\*Correlation is significant at  $p < 0.05$

### 11.5. Correlation between Self-Regulated Online Learning and Internet and Social Networking Experience

The results in Table 4.2 reveal significant positive correlations between self-regulated online learning and students' experiences with the Internet and social networks. Persistence shows the strongest correlations with both Intrapersonal ( $r = 0.414$ ) and Interpersonal Conflicts ( $r = 0.451$ ), indicating that persistent learners are more likely to be exposed to or aware of challenges in online social interactions. The overall correlation between self-regulated learning and internet/social network experience is also significant ( $r = 0.309$ ,  $p < .001$ ), suggesting a meaningful connection between students' learning regulation and their online experiences. Notably, Metacognitive Skills negatively correlate with Interpersonal Conflicts ( $r = -0.144$ ,  $p = 0.049$ ), possibly indicating that more self-aware learners experience fewer social conflicts online.

**Table 4.2.** Correlation between Self-Regulated Online Learning and Internet and Social Networking Experience

Internet and Social Networking Experience	Self-regulated Online Learning					
	Meta-cognitive skills	Time Management	Environmental Structuring	Persistence	Help-Seeking	Overall
Intrapersonal conflicts	-0.076 (.191)	0.098 (.089)	0.348* (.000)	0.414* (.000)	0.255* (.000)	0.289* (.000)
Interpersonal conflicts	-0.144* (.049)	0.074 (.198)	0.276* (.000)	0.451* (.000)	0.280* (.000)	0.258* (.000)
<b>Overall</b>	-0.104 (.072)	0.098 (.089)	0.355* (.000)	0.484* (.000)	0.299* (.000)	<b>0.309*</b> (.000)

\*Correlation is significant at  $p < 0.05$

### 11.6. Correlation between Internet and Social Networking Experience and Students' Attitude toward Learning Mathematics

Table 4.3 presents strong and statistically significant positive correlations between students' internet and social networking experience and their attitude toward learning mathematics. The highest overall correlation is between Overall Internet/Social Network Experience and Overall Attitude ( $r = 0.783$ ,  $p < .001$ ), indicating that students with more engagement or challenges online tend to have more positive attitudes toward learning mathematics. Powerful relationships are noted between enjoyment and both Intrapersonal ( $r = 0.618$ ) and Interpersonal Conflicts ( $r = 0.663$ ), suggesting that emotional involvement in online contexts may positively influence how students perceive mathematics learning.

**Table 4.3.** Correlation between Internet and Social Networking Experience and Students' Attitude toward Learning Mathematics

Students' attitude toward learning Mathematics	Internet and Social Networking Experience		
	Intrapersonal Conflict	Interpersonal Conflict	Overall
Checking Solution	0.144* (.012)	0.094 (.106)	0.136* (.018)
Confidence	0.516* (.000)	0.309* (.000)	0.475* (.000)
Enjoyment	0.618* (.000)	0.663* (.000)	0.717* (.000)
IT and Mathematical Learning	0.566* (.000)	0.687* (.000)	0.697* (.000)

**The Relationship between Self-Regulated Online Learning and Student Attitudes toward Learning Mathematics as Mediated by Internet and Social Networking Experience**

Multiple Solutions	0.458* (.000)	0.480* (.000)	0.525* (.000)
Usefulness of Mathematics	0.456* (.000)	0.384* (.000)	0.476* (.000)
<b>Overall</b>	<b>0.708*</b> <b>(.000)</b>	<b>0.685*</b> <b>(.000)</b>	<b>0.783*</b> <b>(.000)</b>

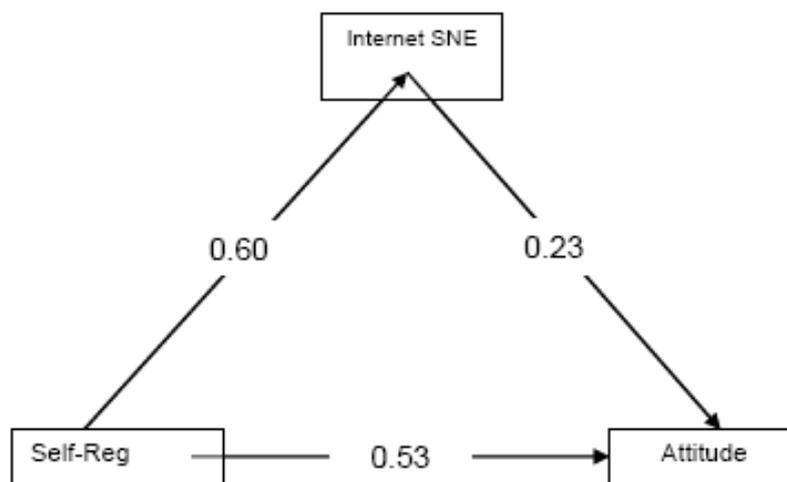
**11.7 Regression Results Indicating Mediating Effects of Internet and Social Networking Experience**

Table 5 provides evidence for a partial mediating effect of internet and social networking experience on the relationship between self-regulated online learning (SR) and attitude toward mathematics (A). The indirect effect is statistically significant ( $\beta = 0.219, p < .001$ ), and the total effect of SR on A is also significant ( $\beta = 0.366, p < .001$ ). The direct path from SR to A remains significant ( $\beta = 0.146$ ), confirming partial mediation. Notably, the pathway from SR to ISN ( $\beta = 0.297$ ) and ISN to A ( $\beta = 0.739$ ) are both substantial, further supporting the mediating role. The percentage of mediation is 26.04%, indicating that over one-fourth of the effect of self-regulated learning on attitudes toward mathematics is explained through students' experiences with the internet and social networks.

**Table 5.** Regression results of the variables in the criteria of the presence of mediating effect

Indirect and Total Effects								
Type	Effect	Estimate	SE	95% C.I. (a)		$\beta$	Z	P
				Lower	Upper			
Indirect	SR $\Rightarrow$ ISN $\Rightarrow$ A	0.361	0.0694	0.225	0.0497	0.219	5.20	< .001
Component	SR $\Rightarrow$ ISN	0.558	0.1036	0.355	0.761	0.297	5.38	< .001
	ISN $\Rightarrow$ M	0.647	0.0322	0.584	0.710	0.739	20.12	< .001
Direct	SR $\Rightarrow$ A	0.241	0.0605	0.123	0.360	0.146	3.99	< .001
Total	SR $\Rightarrow$ A	0.602	0.0887	0.429	0.776	0.366	6.79	< .001

The direct effect of the factors on self-regulated online learning of mathematics, as shown in Table 5, is estimated at 0.241 with a standard error of 0.0605 and a 95% CI ranging from 0.123 to 0.360. This is statistically significant ( $z = 3.99, p < .001$ ), indicating that the factors of self-regulated online learning directly influence student attitudes toward learning mathematics when controlling for the mediating effect of internet and social network experience among students. Since the p-value of 0.001 is lower than 0.05, this means that the relationship is highly significant, and the null hypothesis is rejected. This suggests that self-regulated online learning has a significant direct impact on students' attitudes toward learning mathematics, independent of its influence through internet and social network experiences. Similarly, the data revealed that the total effect was significant ( $B = 0.366, z = 6.79, p < .001$ ).



**Figure 2.** Medgraph showing the variables of the study

## **12. DISCUSSION**

### **12.1 Self-regulated online learning mathematics of the students**

The results reveal that students exhibited a high level of self-regulated online learning across all components, with an overall mean of 3.91 and a relatively low standard deviation of 0.26, indicating consistent responses. Among the indicators, environment structuring and help-seeking received the highest mean scores (3.94), while time management and persistence were slightly lower at 3.90. This suggests that students are particularly skilled at organizing their learning environment and seeking support when needed but may still face challenges in managing time and maintaining consistent effort during online learning sessions.

These findings have several implications. While the high levels of self-regulated behaviors indicate that students are capable of adapting to online learning, the slightly lower scores in time management and persistence highlight areas that could benefit from targeted intervention, such as time management workshops or motivational strategies. The results support Zimmerman's Self-Regulated Learning Theory, which emphasizes the interplay of metacognition, motivation, and behavior. Empirical evidence from Broadbent and Poon (2015) similarly shows that self-regulated learning strategies are critical to student success in online environments, reinforcing the need to develop these skills systematically in digital learning contexts.

### **12.2 Students' attitude toward learning mathematics**

The findings show that students generally have a positive attitude toward mathematics, with an overall mean score of 3.95, and all individual indicators rated as "High." The highest mean is for IT and Mathematics Learning (4.02), indicating strong interest in integrating technology with math education. The lowest mean is in Enjoyment (3.91), suggesting that although students recognize the value of mathematics, their emotional engagement or enjoyment with the subject may be lower. The relatively higher standard deviation in Enjoyment (0.74) suggests that students in this domain have more varied experiences.

This suggests that while students value math and its applications—particularly when combined with technology—there is still room to enhance affective engagement. The findings support Bloom's Affective Domain framework, which posits that positive attitudes toward a subject enhance motivation and learning outcomes. This also aligns with studies by Hannula (2002), which show that enjoyment and interest are vital to long-term mathematics engagement. However, the lower enjoyment levels could imply that instructional strategies may need to be more engaging, culturally responsive, or activity-based to foster a more emotionally positive learning environment.

### **12.3 Internet and Social Network experience of the students**

The results indicate that students have high levels of experience with the internet and social networking, as reflected by overall high ratings in both intrapersonal ( $M = 3.97$ ) and interpersonal conflicts ( $M = 3.99$ ). However, the standard deviation for interpersonal conflicts ( $SD = 0.75$ ) is relatively high, suggesting that while some students experience minimal conflict, others may be encountering significant social challenges online. This variation highlights a complex digital experience that, while enriching and informative, may also introduce psychological and relational stressors.

This finding implies that although the internet and social media platforms are valuable tools for learning and connection, they can also generate internal stress and social tension, particularly among adolescents who are still developing their self-concept and communication skills. The results are consistent with Bronfenbrenner's Ecological Systems Theory, particularly the influence of the mesosystem (peer and digital environments) on students' personal and academic development. Empirical studies, such as those by Keles et al. (2020), confirm that social media use can be linked to increased anxiety and interpersonal conflict, underscoring the need for digital literacy programs that promote healthy online behaviors and emotional regulation.

### **12.4 Relationship between Self-regulated Online Learning and students' Attitude toward Learning Mathematics**

The correlation results reveal a significant positive relationship between self-regulated online learning and students' attitudes toward mathematics, particularly in indicators such as persistence ( $r = 0.474$ ,  $p$

< 0.001), help-seeking ( $r = 0.436$ ,  $p < 0.001$ ), and environmental structuring ( $r = 0.345$ ,  $p < 0.001$ ). These findings suggest that students who are more self-regulated in their online learning are also more likely to have favorable attitudes toward mathematics, including higher confidence, greater enjoyment, and a deeper appreciation for multiple solutions.

This outcome supports the premise that self-regulation not only enhances learning efficacy but also positively shapes students' emotional and cognitive attitudes toward academic subjects. This aligns with Bandura's Social Cognitive Theory, which emphasizes the interrelationship between behavior, cognition, and environment. The findings align with empirical research by Artino and Stephens (2009), which found that self-regulated learners typically hold more positive attitudes toward learning, thereby further validating the idea that fostering self-regulation can indirectly enhance math engagement and motivation.

## **12. 5 Relationship between Self-Regulated Online Learning and Internet and Social Networking Experience**

Significant correlations are also observed between self-regulated online learning and students' internet and social networking experience, with the highest relationships evident in persistence ( $r = 0.484$ ,  $p < 0.001$ ) and environmental structuring ( $r = 0.355$ ,  $p < 0.001$ ). This implies that students who manage their learning behaviors effectively are also better equipped to navigate the challenges of online social environments, such as avoiding distractions or coping with digital stress.

This finding indicates that self-regulated learners are more likely to engage in constructive digital habits and are less susceptible to the negative impacts of social networking, such as intrapersonal or interpersonal conflicts. The result supports Bandura's theory, which posits that self-efficacy is a key factor in managing external environments. It also aligns with the findings of Kitsantas and Dabbagh (2010), who highlight that self-regulated learning strategies help students avoid procrastination and distraction in online settings, reinforcing the benefit of teaching digital self-control and goal-setting techniques.

## **12.6 Relationship between Internet and Social Networking Experience and Students' Attitude toward Learning Mathematics**

A strong, statistically significant relationship exists between students' internet and social networking experiences and their attitudes toward mathematics, with overall correlation values reaching as high as  $r = 0.783$  ( $p < 0.001$ ). Notably, indicators such as enjoyment ( $r = 0.717$ ) and learning in IT and mathematics ( $r = 0.697$ ) are strongly associated with positive online experiences. These results suggest that students who have more balanced or enriching online experiences also exhibit greater enthusiasm and positivity toward learning mathematics.

This relationship underscores the influence of online engagement on academic motivation. Positive social media experiences may reinforce students' belief in the relevance and enjoyability of mathematics, particularly when math content is presented through interactive or relatable digital platforms. These results are consistent with the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the synergy between technology and pedagogy in enhancing student engagement. Empirical studies by Lee (2012) also support this relationship, suggesting that students who use technology meaningfully are more likely to develop interest and confidence in STEM fields.

## **12.7 Mediating Effects of Internet and Social Networking Experience**

Mediation analysis reveals that internet and social networking experience significantly mediate the relationship between self-regulated online learning and attitudes toward mathematics, with an indirect effect size of  $\beta = 0.219$  ( $p < 0.001$ ), accounting for 26.04% of the total effect. This means that part of the influence of self-regulation on mathematics attitudes occurs through students' experiences in online social and informational contexts.

This mediation finding has significant implications for educational practice. Enhancing students' digital literacy and promoting constructive online engagement can strengthen the positive effects of self-regulated learning on math attitudes. From a theoretical standpoint, this supports Bronfenbrenner's Ecological Systems Theory and Vygotsky's sociocultural theory, both of which underscore the role of

social environments in shaping cognitive outcomes. It also supports empirical findings by Liu et al. (2016), which show that digital interactions can serve as a pathway through which academic behaviors influence attitudes, especially in tech-integrated learning environments.

### **13. CONCLUSION**

The study's findings reveal that students generally demonstrate a high level of self-regulated online learning in mathematics, particularly excelling in environment structuring and help-seeking, which both attained the highest mean scores of 3.94. This suggests that students are actively taking initiative in managing their learning environments and seeking assistance when needed—key components of effective self-regulated learning. Other components, such as metacognitive skills, time management, and persistence, also registered high descriptive levels, with time management and persistence scoring the lowest among the indicators ( $M = 3.90$ ). In terms of students' attitudes toward learning mathematics, the results also indicate a high overall level ( $M = 3.95$ ), with the highest mean scores observed in "IT and Mathematics Learning" ( $M = 4.02$ ) and "Multiple Solutions" ( $M = 3.98$ ), highlighting the students' openness to diverse problem-solving strategies and their positive view of integrating technology with mathematics instruction. However, enjoyment has the lowest mean ( $M = 3.91$ ) among the attitude indicators, suggesting that while students recognize the value and utility of mathematics, their emotional engagement with the subject may need further attention. Regarding students' internet and social networking experience, the findings show a high level of usage, though the overall mean ( $M = 3.79$ ) is slightly lower compared to the other constructs. Intrapersonal ( $M = 3.97$ ) and interpersonal conflicts ( $M = 3.99$ ) both ranked high, indicating the dual-edged nature of online connectivity, which can both support and hinder academic focus and emotional well-being.

Inferential statistical analysis reveals several significant correlations among the key variables. Notably, help-seeking behavior from the self-regulated online learning scale is significantly correlated with various dimensions of mathematics attitudes, including enjoyment ( $r = 0.258, p < 0.001$ ), multiple solutions ( $r = 0.559, p < 0.001$ ), and usefulness of mathematics ( $r = 0.306, p < 0.001$ ). Environmental structuring and persistence also show strong correlations with students' attitudes, underscoring the importance of external and internal regulatory processes in influencing learners' outlook toward mathematics. Likewise, persistence is strongly linked to both intrapersonal ( $r = 0.414, p < 0.001$ ) and interpersonal conflicts ( $r = 0.451, p < 0.001$ ) in online social networking, reflecting how self-motivation plays a role in managing digital distractions and relational challenges. The results also demonstrate that internet and social networking experiences significantly influence students' attitudes toward mathematics, with overall correlations as high as  $r = 0.783 (p < 0.001)$ , indicating that positive or negative online experiences can directly shape how students perceive and emotionally engage with the subject. Furthermore, regression analysis and mediation testing confirm that internet and social networking experience partially mediated the relationship between self-regulated online learning and attitudes toward mathematics. The indirect effect is statistically significant ( $\beta = 0.219, p < 0.001$ ), accounting for 26.04% of the total effect, suggesting that while self-regulation directly impacts attitudes, part of this influence is channeled through students' digital social interactions.

These findings support and reinforce the theoretical underpinnings of the study, particularly Zimmerman's Self-Regulated Learning Theory and Bandura's Social Cognitive Theory. Zimmerman posits that metacognitive, motivational, and behavioral components of self-regulation play vital roles in learning success, which this study affirmed through the strong association between self-regulated behaviors and positive learning attitudes. Additionally, Bandura's emphasis on the interaction between personal factors, behavior, and environmental influences is evident in how internet and social networking experiences acted as mediating factors. The findings also align with Vygotsky's sociocultural theory, which emphasizes the significance of social interaction in cognitive development. The partial mediation observed in the model suggests that digital social environments are not merely distractions but active spaces where learners form attitudes, seek support, and engage in self-directed learning. Thus, the empirical results lend robust support to the study's theoretical framework and demonstrate the interconnectedness of cognitive regulation, digital experience, and emotional engagement in the context of online mathematics education.

#### 14. RECOMMENDATION

In light of the study's findings, several recommendations are proposed to enhance students' learning experiences and address the areas identified as needing improvement. First, for teachers and curriculum developers, targeted interventions should focus on strengthening students' time management skills, which received the lowest mean among the self-regulated learning indicators. Teachers can incorporate structured activities such as weekly goal-setting, digital planners, and time audits into their instruction to cultivate students' ability to manage their study schedules effectively. Embedding these skills into the online learning modules can help learners become more autonomous and disciplined in managing their academic tasks.

Second, school administrators and guidance counselors should address the high levels of intrapersonal and interpersonal conflicts arising from students' use of the Internet and social networking. Schools can offer digital literacy programs, stress-reduction workshops, and peer mentoring sessions that help students build emotional resilience and responsible online behaviors. Providing psychosocial support and awareness programs on digital wellness will help mitigate the adverse emotional and relational effects of excessive or problematic online engagement, which, as the findings suggest, may influence students' academic attitudes and behaviors.

Third, educational technology developers and policymakers should work toward improving the enjoyment aspect of learning mathematics, which is rated lowest among the attitude indicators. This can be achieved by developing interactive, game-based, or real-world application platforms that integrate elements of fun and engagement into mathematical learning. Policies that promote the integration of these tools into standard learning practices should also be supported. Lastly, parents and guardians should play an active role by providing a conducive learning environment at home and monitoring students' internet use. With appropriate parental support, students can develop stronger persistence and more effective help-seeking behavior while also avoiding the adverse effects of unmanaged online activity. These multi-stakeholder recommendations, grounded in the study's findings, aim to foster a more supportive and effective digital learning environment for mathematics education.

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**STATISTICAL TABLES**

**Table 1.1.** Level of self-regulated online learning mathematics of the students in terms of Metacognitive Skills

Indicators	Mean	Standard Deviation	Descriptive Level
1. I think about what I really need to learn before I begin a task in an online subject.	3.903	1.128	High
2. I ask myself questions about what I am to study before I begin to learn in an online subject.	3.867	1.125	High
3. I set short-term (daily or weekly) goals as well as long-term goals (monthly or for the whole online subject).	3.893	1.172	High
4. I set goals to help me manage my studying time in an online subject.	3.957	1.137	High

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5. I set specific goals before I begin a task in an online subject.	3.913	1.148	High
6. I think of alternative ways to solve a problem and choose the best one for an online subject.	3.847	1.146	High
7. I use strategies in an online subject that have worked in the past.	3.873	1.111	High
8. I have a specific purpose for each strategy I use in an online subject.	3.940	1.167	High
9. I am aware of what strategies I use when I study for an online subject.	4.030	1.000	High
10. I distribute my studying time for an online subject evenly across days.	3.877	1.107	High
11. I periodically review to help me understand important relationships in an online subject.	3.807	1.189	High
12. I find myself pausing regularly to check my comprehension of an online subject.	3.863	1.126	High
13. I ask myself questions about how well I am doing while learning something in an online subject.	3.957	1.104	High
14. I think about what I have learned after I finish working on an online subject.	4.010	1.080	High
15. I ask myself how well I accomplished my goals once I'm finished working on an online subject.	3.907	1.138	High
16. I change strategies to make progress while learning for an online subject.	3.857	1.143	High
17. I find myself analyzing the usefulness of strategies while I study for an online subject.	3.917	1.114	High
18. I ask myself if there were other ways to do things after I finish learning for an online subject.	3.893	1.200	High
<b>Overall</b>	<b>3.91</b>	<b>0.32</b>	<b>High</b>

**Table 1.2.** Level of self-regulated online learning mathematics of the students in terms of Time Management

Indicators	Mean	Standard Deviation	Descriptive Level
1. I find it easy to stick to a study schedule for an online subject.	3.930	1.130	High
2. I make sure I keep up with the weekly readings and assignments for an online subject.	3.857	1.126	High
3. I find that I do spend very much time on an online subject than of other activities.	3.923	1.138	High
<b>Overall</b>	<b>3.90</b>	<b>0.66</b>	<b>High</b>

**Table 1.3.** Level of self-regulated online learning mathematics of the students in terms of Environmental Structuring

Indicators	Mean	Standard Deviation	Descriptive Level
1. I choose the location where I study for an online subject to avoid too much distraction.	3.813	1.182	High
2. I find a comfortable place to study for an online subject.	3.993	1.069	High
3. I know where I can study most efficiently for an online subject.	3.993	1.069	High
4. I have a regular place set aside for studying an online subject.	4.003	1.105	High
5. I know what the instructor expects me to learn in an online subject.	3.893	1.125	High
<b>Overall</b>	<b>3.94</b>	<b>0.55</b>	<b>High</b>

**Table 1.4.** Level of self-regulated online learning mathematics of the students in terms of Persistence

Indicators	Mean	Standard Deviation	Descriptive Level
1. When I am feeling bored studying for an online subject, I force myself to pay attention.	3.843	1.136	High
2. When my mind begins to wonder during a learning session for an online subject, I make a special effort to keep concentrating.	3.867	1.107	High
3. When I begin to lose interest for an online subject, I push myself even further.	4.047	0.994	High
4. I work hard to do well in an online subject even if I don't like what I have to do.	3.947	1.093	High

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5. Even when materials in an online subject are dull and uninteresting, I manage to keep working until I finish.	3.790	1.188	High
<b>Overall</b>	<b>3.90</b>	<b>0.62</b>	<b>High</b>

**Table 1.5.** Level of self-regulated online learning mathematics of the students in terms of Help Seeking

Indicators	Mean	Standard Deviation	Descriptive Level
1. When I do not fully understand something, I ask my classmates in an online subject for ideas.	3.880	1.139	High
2. I share my problems with my classmates in an online subject so we know what we are struggling with and how to solve our problems.	4.047	1.059	High
3. I am persistent in getting help from the teacher of an online subject.	3.913	1.142	High
4. When I am not sure about some material in an online subject, I check with other people.	4.003	1.049	High
5. I communicate with my classmates to find out how I am doing in an online subject.	3.880	1.115	High
<b>Overall</b>	<b>3.94</b>	<b>0.52</b>	<b>High</b>

**Table 2.1.** Level of students' attitude toward learning mathematics in terms of Checking Solutions

Indicators	Mean	Standard Deviation	Descriptive Level
1. When I know I have made a mistake in solving a problem, I will try to find out why.	3.973	1.037	High
2. After I have solved a problem, I will go through the solution again and check if I have made any mistakes.	4.030	1.061	High
3. Once I have worked out an answer to a problem, I do check my answer.	4.017	0.997	High
4. After I have solved a problem, I will ask myself if the answer makes sense to the given problem.	3.747	1.192	High
<b>Overall</b>	<b>3.94</b>	<b>0.56</b>	<b>High</b>

**Table 2.2.** Level of students' attitude toward learning mathematics in terms of Confidence

Indicators	Mean	Standard Deviation	Descriptive Level
1. I am good at using Mathematics to solve real-life problems.	3.867	1.186	High
2. I am confident in solving Mathematics problems.	3.980	1.076	High
3. I find mathematics easy.	3.893	1.149	High
4. I am good at giving reasons in Mathematics.	3.947	1.141	High
<b>Overall</b>	<b>3.92</b>	<b>0.57</b>	<b>High</b>

**Table 2.3.** Level of students' attitude toward learning mathematics in terms of Enjoyments

Indicators	Mean	Standard Deviation	Descriptive Level
1. I enjoy doing Mathematics.	3.953	1.138	High
2. I find Mathematics interesting.	3.840	1.174	High
3. I have good feelings about Mathematics.	3.910	1.128	High
4. I find solving Mathematics problems fun.	3.930	1.187	High
<b>Overall</b>	<b>3.91</b>	<b>0.74</b>	<b>High</b>

**Table 2.4.** Level of students' attitude toward learning mathematics in terms of IT and Mathematics Learning

Indicators	Mean	Standard Deviation	Descriptive Level
1. I do like to use the computer to learn Mathematics.	4.020	1.082	High
2. I can learn Mathematics from playing computer games.	4.057	1.088	High
3. IT (Information Technology) has been helpful to my Mathematics learning.	3.977	1.102	High
4. Mathematics software (e.g., graphing) helps me learn Mathematics.	4.013	1.069	High
<b>Overall</b>	<b>4.02</b>	<b>0.69</b>	<b>High</b>

**Table 2.5.** *Level of students' attitude toward learning mathematics in terms of Multiple Solutions*

Indicators	Mean	Standard Deviation	Descriptive Level
1. I do like to think of other ways to solve the same problem.	3.943	1.139	High
2. I figure out different ways to solve Mathematics problems.	4.077	0.963	High
3. I understand the different solutions given by my classmates.	3.947	1.129	High
4. After I have solved a problem, I look for other methods to solve it.	3.957	1.122	High
<b>Overall</b>	<b>3.98</b>	<b>0.65</b>	<b>High</b>

**Table 2.6.** *Level of students' attitude toward learning mathematics in terms of Usefulness of Mathematics*

Indicators	Mean	Standard Deviation	Descriptive Level
1. Mathematics is important for me.	3.997	1.065	High
2. I think Mathematics is useful in solving real world problems.	3.973	1.044	High
3. I think Mathematics is useful for tests.	3.990	1.090	High
4. Mathematics helps me to understand reports and advertisements about prices, sales, percentages etc.	3.957	1.166	High
<b>Overall</b>	<b>3.96</b>	<b>0.60</b>	<b>High</b>

**Table 3.1.** *Level of internet and social network experience of the students in terms of Intrapersonal Conflicts*

Indicators	Mean	Standard Deviation	Descriptive Level
1. When I am in trouble, getting online helps me escape from them.	3.947	1.067	High
2. I often anticipate my next online connections.	3.973	1.069	High
3. I often think life without internet is boring, empty and sad.	3.967	1.133	High
4. If someone disturbs me while I am connected online, I often get angry or irritated.	4.000	1.100	High
5. When I am navigating through the internet, I feel time flies.	3.920	1.163	High
6. I think relating to people through internet is easier or more convenient than face to face.	4.010	1.102	High
<b>Overall</b>	<b>3.97</b>	<b>0.61</b>	<b>High</b>

**Table 3.2.** *Level of internet and social network experience of the students in terms of Interpersonal Conflicts*

Indicators	Mean	Standard Deviation	Descriptive Level
1. I often make new friends in the internet.	3.950	1.122	High
2. I often catch-up things when I am online.	4.007	1.112	High
3. My academic performance has been positively affected due to my internet use.	4.017	0.986	High
4. When I am connected to the Internet, I feel relax and comfortable.	3.983	1.114	High
<b>Overall</b>	<b>3.99</b>	<b>0.75</b>	<b>High</b>

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**Susan Elicot Pacaldo** is a committed public secondary school teacher with fourteen years of teaching experience. Throughout her career, she has demonstrated a strong dedication to academic excellence and student achievement. She has served as a coach for Sudoku competitions, producing champions at both the division and district levels. Her leadership also brought home a 4th place win in the Sudoku category at the 21st National Science Quest held in Baguio City. In May 2025, she presented her research study at the Professional School

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