Assessing Self-Discipline and Mathematics Achievement among Upper Secondary School Students in Malaysia during Home Online Learning Initiative: A Gender Comparison

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***Abstract*—In response to the COVID-19 Movement Control Order, the Malaysian Ministry of Education launched the Home Online Learning initiative, offering a viable alternative to traditional in-person schooling. However, the successful implementation of Home Online Learning relies heavily on students' self-discipline to effectively absorb and retain the knowledge being delivered. This study aims to explore the level of self-discipline among upper secondary students and its correlation with their mathematics achievement in the national examination (SPM). The study additionally investigates any gender differences in self-discipline and mathematics achievement during the Home Online Learning initiative. Descriptive and inferential analyses were employed in this study, utilizing a quantitative, non-experimental, cross-sectional survey design. Data were collected through an online questionnaire from a sample of 165 high school students. The results revealed that most students displayed a high level of self-discipline, which positively influenced their mathematics achievement. Regarding gender differences, the analysis revealed that there was no significant disparity in self-discipline levels between male and female students during the Home Online Learning period. Both groups displayed similar abilities in managing self-discipline effectively, although specific items indicated that male students exhibited stricter adherence to avoiding social media distractions, postponing negative thoughts, managing interruptions, maintaining concentration, and effectively utilizing study time. However, there was an equivalent degree of self-discipline observed among both male and female students. This study contributes to a better understanding of the challenges and mathematics achievement among upper secondary school students. The findings emphasize the importance of cultivating self-discipline during Home Online Learning and provide valuable insights for educators and policymakers to develop effective strategies and interventions. Students' eagerness to engage in online learning was evident, indicating their readiness to embrace virtual learning, especially during the implementation of the Home Online Learning initiative.**

***Keywords*—self-discipline, mathematics learning, mathematical achievement, online learning, gender comparison**

I. Introduction

The COVID-19 pandemic has had a profound impact on the education sector, prompting a shift towards digitalization and virtual classrooms [1]. As a result, traditional face-to-face learning was replaced by remote learning strategies such as Home Online Learning. While we are currently transitioning into the post-pandemic stage, the strategies implemented during this period offer valuable insights into learning behavior and its pedagogical impacts. In response to the pandemic, the Malaysian Ministry of Education implemented Home Online Learning to ensure the continuous provision of education for both primary and secondary school students.

Home Online Learning involves adapting to remote learning from both a physical and mental perspective, which can be particularly challenging for school students who may lack the maturity to manage their lives independently. Therefore, self-discipline plays a crucial role in the success of Home Online Learning implementation. Self-discipline can be characterized as the ability to engage in tasks or activities that are perceived as necessary, even in the absence of motivation [2]. It encompasses qualities such as perseverance, restraint, decision-making, and the ability to follow through with plans, even in difficult situations or when facing obstacles [3]. Developing self-discipline is essential for students to overcome laziness, uncertainty, and fear.

The relationship between self-discipline and academic achievement, specifically in mathematics, has been a subject of research interest. University studies have indicated that self-discipline can be a better predictor of academic performance among students when compared to other factors [4]. Among the most common obstacles faced by students who have limited exposure to virtual learning environments is the struggle with self-discipline [5]. However, with the increased reliance on online education, it becomes pertinent to investigate the influence of self-discipline on mathematics achievement among high school students.

Additionally, gender differences in academic performance have been observed, with studies indicating that female students tend to perform better academically [6]. It is crucial to examine whether these gender differences in self-discipline and academic achievement persist when teaching and learning are conducted entirely online.

Therefore, this study aims to assess the level of self-discipline among secondary school students, particularly those who have already taken the national examination. The focus will be on measuring self-discipline during the Home Online Learning period leading up to the 2020 national examination (SPM). The students' mathematics achievement will be analyzed after the results are announced in June 2021.

This analysis aims to determine if a significant relationship exists between the level of self-discipline and mathematics achievement in the 2020 national examination (SPM). To address these research objectives, the following research questions will be explored:

1) Is there a significant difference in perceived self-discipline during Home Online Learning between genders?
2) Is there a significant difference in mathematics learning achievement during Home Online Learning between genders?
3) Is there a significant relationship between self-discipline and mathematics learning achievement based on gender?

By investigating these research questions, this study aims to contribute to a better understanding of the role of self-discipline in online learning contexts, particularly concerning mathematics achievement among high school students

II. Literature Review

A. Self-Discipline

Self-discipline plays a crucial role in the process of learning mathematics, especially in the context of Home Online Learning. It encompasses the ability to control one's desires, emotions, and thoughts and adapt behavior to meet short- and long-term goals, such as concentrating during online learning and achieving success in the national examination (SPM) mathematics exam. Researchers have highlighted that self-discipline involves exhibiting goal-directed behavior and can lead to positive changes [7]. To establish self-discipline, individuals must set significant goals and make dedicated efforts to attain them [8].

Self-discipline has wide-ranging implications for various aspects of human life [9]. Therefore, the development of self-discipline should be encouraged by the government, schools, and parents to ensure that individuals acquire this valuable skill [8, 10]. In the early adult phase, self-discipline becomes particularly important as individuals make critical decisions for their personal and professional lives [11]. While university students often have more experience in managing their lives, primary and high school students may still be developing their abilities in self-discipline. Low self-discipline among students can lead to negative consequences [12].

A study conducted by Duckworth *et al.* [13] investigated the role of self-control and IQ in academic achievement among high school students. The researchers found that self-control was a better predictor of improvement in report card grades over time compared to IQ. These findings indicate that self-discipline is strongly associated with student academic achievement, including GPA scores.

Investigating the gender differences in self-discipline during Home Online Learning is essential to understand how male and female students adapt to online learning environments [14]. Several studies have explored gender variations in self-discipline and found mixed results. By conducting a comparative analysis, this study aims to determine if there is a significant difference in perceived self-discipline between genders during Home Online Learning.

B. Home Online Learning in the Era of COVID-19

The COVID-19 pandemic has necessitated a shift from traditional face-to-face teaching to Home Online Learning worldwide. However, the transition to Home Online Learning poses challenges in terms of self-preparation and adapting to virtual learning environments. Several studies have explored the effectiveness of online learning compared to traditional classroom learning. Flores and Marilia [15] found that traditional learning methods are still preferred over virtual learning. Furthermore, Dawadi *et al.* [16] highlighted that online learning in low-income countries may exacerbate existing inequalities due to disparities in socio-economic backgrounds and educational access. The digital divide and unequal access to e-learning can further widen the gap between privileged and disadvantaged students [16].

Additionally, certain subjects, such as mathematics, chemistry, biology, and physics, are challenging to teach effectively through online platforms due to the limitations of hands-on instruction [17]. Although online learning has gained prominence, students still prefer face-to-face classroom learning because it allows for real-time interactions with teachers and peers [18]. Distance learning, while serving as an alternative to in-person teaching, presents numerous challenges for both students and educators.

In light of these considerations, investigating the impact of gender on mathematics learning achievement during Home Online Learning needs to be examined. Existing literature has acknowledged gender differences in academic achievement [14], and it is crucial to investigate if these disparities persist in the context of online learning. This study aims to assess if there is a significant difference in mathematics learning achievement between male and female students during Home Online Learning.

C. Academic Achievement

Research has shown that self-discipline plays a significant role in academic achievement. Brigman and Campbell [19] conducted a study involving primary and secondary school students to determine whether a counselling intervention could lead to improvements in cognitive, social, self-management, and academic performance. The results revealed that students who received the intervention demonstrated improved behavior, leading to a 22% increase in academic performance. These findings highlight the importance of self-discipline in enhancing cognitive, social, and self-management skills, contributing to academic success [20, 21].

Understanding the relationship between self-discipline and mathematics learning achievement is vital, particularly in the context of gender. Previous research as mentioned above has shown that self-discipline significantly influences academic performance. This study aims to investigate if the relationship between self-discipline and mathematics learning achievement varies between genders during Home Online Learning.

Overall, by examining gender differences in self-discipline and mathematics learning achievement during Home Online Learning, this study seeks to provide insights into the unique

challenges and outcomes experienced by male and female students in the online learning environment. This comprehensive analysis will contribute to a deeper understanding of how gender influences the effectiveness of Home Online Learning and its impact on self-discipline and academic achievement

III. Materials and Methods

This study aims to examine the level of self-discipline among upper secondary school students towards virtual learning. The research hypotheses are tested using descriptive and inferential data analysis methods, answering research questions related to the level of self-discipline. Descriptive statistics are used to explain the level of student self-discipline and their mathematics achievement in the national examination (SPM). Descriptive statistical analysis provides an easy representation of summary statistics and meaningful graphs to depict the dataset [22, 23].

The data are presented in the form of means, Standard Deviations (SD), frequencies (f), and percentages (%). Inferential statistics are employed to analyze the difference in self-discipline levels between male and female students. Inferential statistics allow drawing conclusions from data subject to sampling variation, enabling predictions and generalizations about a larger population based on the study of a smaller sample [24, 25].

Additionally, the Spearman correlation test was conducted to determine the relationship between two variables. The Spearman correlation test is a non-parametric analysis conducted to analyze data collected through a questionnaire survey instead of the commonly used Pearson correlation test, which measures the linear relationship between two normally distributed variables [26, 27]. This widely used technique requires assumptions such as the absence of outliers and homoscedasticity between the variables of interest. The reliability of the correlation analysis relies on adequate sample size ($n \geq 10$) and the fulfilment of these assumptions [28, 29]. In this study, the researchers employed this technique to predict students expected mathematical academic performance based on the relationship between self-discipline and achievement.

This study adopts a quantitative research method as it is suitable for analyzing data from many respondents [30]. The quantitative approach is appropriate for probability sampling, facilitating more accurate generalizability using standardized and closed-ended questions. It allows respondents to provide feedback at their own pace and reduces costs when dealing with larger samples [31, 32].

The study design utilizes a cross-sectional survey approach, which is quantitative and non-experimental. This approach enables the analysis of data across a sample population at a specific point in time. Cross-sectional surveys are cost-effective and straightforward methods for collecting initial data, enabling the examination of correlations between normally distributed variables and comparisons between groups at a specific moment [33–35]. Two sets of instruments were adapted from [36, 37] to form a unified set of Likert five-point scale instruments According to the suitability of the study requirements. The instrument consists of two sections, Section A details the demographics of the respondents and their 2020 SPM mathematics grades, whereas Section B is dedicated to the Self-Discipline Survey in Academics. The survey was conducted through a questionnaire distributed using Google Forms and the WhatsApp application. This method allows for detailed comparisons and enhances objectivity in the comparison of variables [38–40].

The target population for this study comprises Form Five students from two schools in Johor. A sample size of 165 students was determined based on [41] formula. The researchers extracted questionnaire items from two sets of instruments, selecting items in line with the study's objectives, and combining them into one instrument. The researchers distributed the questionnaire link to teachers in the selected schools and requested them to share it with individuals who had completed the national examination (SPM) as part of their academic journey. The acceptance of questionnaire responses was closed once 165 data points were obtained. The data were analyzed using IBM SPSS software version 22.

IV. Result and Discussion

The results conceded that of 165 respondents involved, 56 of them are male (33.9%) and 109 are female (66.1%). These statistics indicated that the number of female respondents was more than male with a ratio of approximately 1:2 (Male: Female). The respondents consisted of Malay, Chinese, Indian and others (Bumiputera, etc.). The total number of Malay students involved as respondents in this study was 118 people (71.5%), 33 people (20%), Chinese 11 people (6.7%) and Indians 3 people (1.8%). Next, 112 people (67.9%) have an excellent level of performance, that is obtaining grades A+, A and A– in Mathematics subjects, while 34 people (20.6%) have a moderate level of performance, i.e., an honors level in the range of grades B+, B, C+ and C, and only 19 respondents (11.5%) who obtained grades D, E and G which were interpreted as less than excellent person had answered this questionnaire as indicated in Fig. 1.

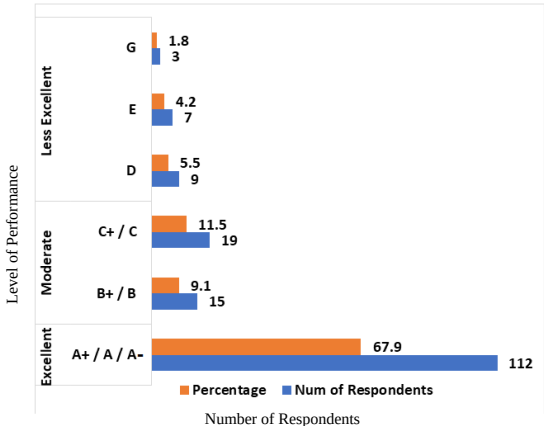

Fig. 1. Number of respondents according to the level of academic achievement.

The study found that the level of student self-discipline during Home Online Learning throughout the COVID-19 Movement Control Order was at a good level for both schools studied. It can be seen in data analysis where most students know how they manage learning at home.

Respondents from both schools mostly have high self-discipline and only a small number of students lack self-discipline. There were only five items where the majority of the respondents felt "Not Sure" with the given statement, that was whether they woke up at the same time every day or not, did not use social media while studying, did not allow the will to control themselves while studying, can pay full attention while studying despite distractions, and took lots of notes for online classes. Even so, the mode for 16 items indicated that most of the respondents have high self-discipline where the mode of 48 to 65 respondents was obtained for each item "Agree" and the mode of 44 to 95 respondents was obtained for each item "Strongly Agree". The level of self-discipline can be said to be good due to there being no items that have a mode on the "Strongly Disagree" scale and "Disagree".

The findings of the study revealed several key points regarding the level of self-discipline among upper-secondary students during virtual learning. Firstly, most respondents showed good self-discipline, as indicated by the data analysis. Most students showed an understanding of how to manage their learning at home, suggesting they could adapt to the challenges of online education during the COVID-19 Movement Control Order. This finding aligns with previous studies [42] that have highlighted the ability of students to effectively engage in e-learning.

Although the overall level of self-discipline was good, certain areas showed a lack of discipline in some students. These findings offer new insights into how students adapt self-discipline strategies in response to unprecedented educational challenges contradicting to study by Zheng and Xiao [43] which emphasizes self-discipline in conventional educational settings. The finding emphasizes the importance of guiding students in developing self-discipline strategies during virtual learning. The study suggests that teachers should emphasize the significance of minimizing distractions and dedicating focused time to studying, which can positively impact students' academic performance. As a deeper examination into gender-specific self-discipline strategies, this study extends Tsaousis and Alghamdi's [44] findings of minimal gender differences in self-discipline, by providing a deeper understanding of these dynamics in the context of pandemic-induced online education. The insights gained highlight the complexity of gender-specific learning behaviors in disrupted educational environments and point towards the need for more customized educational strategies.

While Malaysia has made progress in fostering equity and inclusivity, this study found that there is no significant difference in self-discipline levels between male and female students during Home Online Learning. Both genders were equally adept at managing self-discipline. Such equality may result from the online environment's levelling effect, as Yin *et al.* [45] observed digital platforms reducing traditional gender gaps in academics. Family Structures and Responsibilities, particularly aspects like Parental Modeling and Educational Emphasis within the Family, can play a crucial role in shaping behaviors related to discipline, potentially leading to similar levels of discipline among both male and female students [46].

However, a detailed examination of specific behaviors in this study showed that male students demonstrated greater self-discipline in several aspects: avoiding social media; they could postpone bad thoughts while studying; postponing distractions; maintaining concentration even if external distractions occurred; and effectively managing stress. This finding aligns with Apoko and Sya'Ban [47] who underscored the significance of an engaging online learning environment and the impact of online systems like Google Meet on student motivation, highlighting crucial factors in student engagement and discipline in online settings during the COVID-19 pandemic.

Moreover, the respondents of male students also tend to use study time better than the respondents of female students, as indicated in Table 1 for the mean rank value of the Mann-Whitney U Test. Overall, the level of self-discipline was found to be similar among male and female respondents. However, these differences, though not statistically significant, suggest that in specific areas, male students may exhibit slightly higher levels of self-discipline. of self-discipline in these specific areas. This finding is particularly valuable as it underscores the complexities and intricacies of gendered learning behaviors in pandemic educational settings, offering guidance for more tailored educational strategies.

Table 1. Mann-Whitney U test based on mean rank type sizes for final papers

Item	Gender	N	Mean Rank
1	Male	56	79.36
	Female	109	84.87
2	Male	56	81.11
	Female	109	83.97
3	Male	56	82.11
	Female	109	83.46
4	Male	56	76.95
	Female	109	86.11
5	Male	56	81.70
	Female	109	83.67
6	Male	56	85.20
	Female	109	81.87
7	Male	56	76.79
	Female	109	86.19
8	Male	56	85.63
	Female	109	81.65
9	Male	56	87.84
	Female	109	80.51
10	Male	56	86.79
	Female	109	81.06
11	Male	56	86.91
	Female	109	80.99
12	Male	56	78.94
	Female	109	85.09
13	Male	56	81.95
	Female	109	83.54
14	Male	56	79.96
	Female	109	84.56
15	Male	56	80.81
	Female	109	84.12
16	Male	56	83.62
	Female	109	82.68
17	Male	56	75.75
	Female	109	86.72
18	Male	56	74.78
	Female	109	87.22
19	Male	56	72.98
	Female	109	88.15
20	Male	56	71.77
	Female	109	88.77
21	Male	56	73.20
	Female	109	88.04

Fig. 2 depicts the mathematics subject grades in the 2020 national examination (SPM) for addressing the second research question. From the study analysis, more than half of the students from these two selected schools obtained excellent results, which are A+, A, and A–. It can be proven when the median, mode, 25th, and 50th percentiles of the data set were at code 1, which refers to an excellent level. The achievement of Mathematics subjects in these schools was considered good even though students only conducted teaching and learning from home and rarely had face-to-face meetings during the previous pandemic period. The excellent grades obtained show that students could study independently, use or find learning materials on the internet, and take advantage of online learning. Respondents who obtained an honors grade or moderate level in Mathematics were also numerous—around 20.6% of students. Finally, from the entire student achievement data, only three students failed in this Mathematics subject, which was no more than 1.8%.

Yue and Dovan [48] found that self-discipline significantly predicted academic achievement in students. This result, which was corroborated by Shi and Qu [49], demonstrated the significance of self-efficacy beliefs in maths achievement and indicated that these aspects should be investigated in the context of self-discipline.

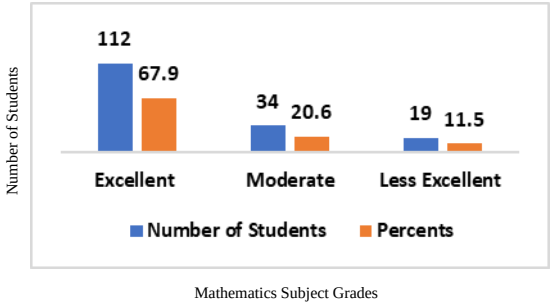

Fig. 2. Mathematics subject grades in SPM 2020.

These findings serve as a guide for the selection of a correlation test to examine the relationship between self-discipline and academic achievement in Mathematics. To determine the relationship between the level of self-discipline of upper secondary school students in online learning and the achievement of Mathematics subjects in the 2020 national examination (SPM), the researcher conducted a Spearman correlation test. The results of the analysis are shown in Table 2 below.

Table 2. Spearman correlation test

Correlation			Mathematics grades in the 2020 national examination (SPM)	Level of self-discipline
Spearman's rho	Mathematics grades in 2020 national examination (SPM)	Correlation Coefficient	1.000	-0.263**
		Sig. (2-tailed)		0.001
		N	165	165
	Level of self-discipline	Correlation Coefficient	-0.263**	1.000
		Sig (2-tailed)	0.001	
		N	165	165

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

Regarding academic achievement, in answering Research Question 3, the study revealed a positive correlation between self-discipline and academic performance in the mathematics subject. Students who exhibited higher levels of self-discipline tended to achieve better grades. The results of the study were consistent with previous research conducted by researchers [41–43] highlighting the impact of self-discipline on students' academic performance. Even though the findings align with the well-established relationship between self-discipline and academic achievement, Duckworth and Seligman [50] provide valuable insights into the relationship between self-discipline and academic achievement. Therefore, this study lies in its contextualization of the correlation between self-discipline and academic achievement within the specific setting of the Home Online Learning initiative during the COVID-19 pandemic, as well as its nuanced exploration of gender-specific self-discipline behaviors.

In this study, while some students were occasionally engaged with social media during online classes, it did not imply a lack of interest in e-learning. The data obtained revealed a significant positive correlation between the level of self-discipline during Home Online Learning and students' performance in the mathematics subject. As the level of self-discipline increased, students' performance showed an upward trend in terms of achieving an excellent level. Despite having internet access to social media, students still utilize online resources for learning, indicating their interest in e-learning. This finding underscores the importance of teachers providing guidance to students regarding the effective use of online resources and encouraging them to prioritize e-learning activities. The study's findings supported the hypothesis that the level of self-discipline in e-learning influences students' academic performance in Mathematics.

Furthermore, it was concluded that if students improve their level of self-discipline in e-learning, it can positively impact their academic achievement. The study also highlighted the students' willingness to engage in e-learning, as evidenced by their active use of online resources and educational games. This indicates that students were motivated to utilize e-learning platforms, despite the presence of social media distractions. In previous study conducted by Anuar and Erda [42] also indicated the willingness of students to apply e-learning was at a moderate level. Teachers can leverage this motivation by encouraging

students to prioritize e-learning activities and providing clear instructions on utilizing online resources effectively.

V. Conclusion

In conclusion, the study revealed that upper secondary school students demonstrated a good level of self-discipline during virtual learning, with both male and female students demonstrating similar abilities in managing self-discipline. Subtle behavioral variations were noted, such as male students' stricter avoidance of social media and better stress management. This insight is probably because of the parental involvement factor and Self-Directed Learning Approach. The findings also highlight the significance of minimizing distractions and providing guidance to enhance students' self-discipline during online education. Investigating the reasons behind these variations, are potential areas for further exploration. Furthermore, the study emphasized the positive correlation between self-discipline and academic achievement, underscoring the necessity for implementing strategies to cultivate self-discipline among students to enhance their performance in Mathematics, especially in online education. This correlation echoes the findings of recent significant studies, which emphasize the influence of gender stereotypes on academic performance in mathematics, suggesting that social perceptions may play a role in shaping students' learning attitudes and outcomes.

The constraints inherent in this study, including its sample size and geographical scope, may affect the generalizability of the results. Future research could explore these dynamics in more diverse and larger populations to validate and expand upon these findings. Moving forward, it is imperative to consider the impact of student-centered pedagogy and course transformation on fostering students' learning experiences in higher education. Additionally, the significant impact of the COVID-19 pandemic on mental health and the transition to online learning, future research should explore the effects of COVID-19-related stress and fear on students' self-discipline and academic achievement.

Moreover, investigating the relationship between digital media self-efficacy, socioeconomic background, and students' performance in Mathematics can provide valuable insights for developing interventions to enhance self-discipline and academic achievement. Lastly, exploring the differences in self-regulated learning strategies among gifted and high-achieving students from diverse socioeconomic levels can inform the development of tailored interventions to enhance self-discipline and academic achievement.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

SN conducted the research and analyzed the data; SN and SO wrote the paper; NI and DK reviewed the paper; NM and SO formatted and edited the paper; all authors approved the final version.

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