mathematics

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The Influence of Student Engagement on Mathematical Achievement among Secondary School Students

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Abstract: Student engagement is a multidimensional construct that predicts learning performance. However, student engagement receives limited attention, especially in mathematics. Thus, this study conducts a survey to determine the influence of student engagement on mathematical achievement. Stratified random sampling was employed to select secondary school students (n = 1000). Questionnaires and end-of-year examination grades were collected as data on student engagement and respective mathematics achievement. The findings indicate that there is a significant relationship between cognitive engagement, affective engagement, behavioural engagement, and mathematical achievement. The results of multiple linear regression analysis show that affective engagement is the largest predictor of mathematical achievement ($\beta = 0.743$, $p < 0.001$), followed by behavioural engagement ($\beta = 0.585$, $p < 0.001$), and cognitive engagement ($\beta = -0.375$, $p < 0.01$). This suggests that policymakers should formulate a curriculum that enables the improvement of affective and behavioural engagement. Furthermore, this study recommends that school administrators and teachers plan and implement activities that stimulate such engagement.

Keywords: mathematics achievement; affective engagement; cognitive engagement; behavioural engagement; student engagement

Citation: Maamin, M.; Maat, S.M.; H. Iksan, Z. The Influence of Student Engagement on Mathematical Achievement among Secondary School Students. *Mathematics* **2022**, *10*, 41. https://doi.org/10.3390/math10010041

Academic Editor: David Pugalee

Received: 3 December 2021
Accepted: 21 December 2021
Published: 23 December 2021

1. Introduction

The issue of student mathematics achievement has been on the international agenda [1–3] for many years [4–6]. Examples of mathematical achievement issues can be seen in student achievement in international assessment, such as in the Programme for International Student Assessment (PISA), a topic of discussion among researchers for much of the 21st century [7–9]. Many studies have focused on identifying the factors that cause mathematical achievement problems [10–12]. Previous studies have reported the factors that influence student academic achievement as being student factors [13–15], teacher factors [16–18], family factors [19–21], and school factors [22,23]. Although many factors influence mathematics achievement, previous studies have focused more on student factors in dealing with this problem, especially studies originating from Association of Southeast Asian Nations (ASEAN) countries [24].

The student factors identified as influencing mathematical achievement are demography, gender, attitude, knowledge, and student engagement [24]. Student engagement is a multidimensional construct, often associated with academic achievement predictors [15,25]. Based on the previous literature review, research gaps still exist in terms of student engagement and related academic achievement. First, most studies only examine student achievement as a whole, without focusing on mathematics subjects [26–28]. Second, most studies do not focus simultaneously on student engagement from the cognitive, behavioural, and affective dimensions [29,30]. Third, most studies focus on student engagement in institutions of higher learning [31,32], especially in Malaysia [33].

Therefore, this study has two objectives:

1. To determine the relationship between student engagement and the mathematical achievement of secondary school students.
2. To determine the largest predictor of student engagement dimensions that influences the mathematical achievement of secondary school students.

There has been little research linking student engagement and mathematical achievement [25], which provides an opportunity to investigate the subject further. Similarly, the timely call for studies that are capable of identifying predictors across all of the engagement factors is explored. Based on the objectives, we investigated the following hypotheses:

Hypothesis 1 (H1). *There is a significant relationship between student engagement and the mathematical achievement of secondary school students*.

Hypothesis 2 (H2). *Cognitive engagement, behavioural engagement and affective engagement are significant predictors of the mathematical achievement of secondary school students*.

2. Literature Review

2.1. Student Engagement

In the early stages, student engagement studies were concerned with emotional and behavioural withdrawal or disengagement from school, with behavioural engagement focusing on participation and emotional engagement focusing on identification [34]. Both are fundamental in the Participation–Identification Model [34]. Specifically, low behavioural engagement leads to students not finishing school. The author in [35] defines student engagement as "the student's psychological investment in and effort directed toward learning, understanding, or mastering the knowledge, skills, or crafts that academic work is intended to promote", and it is a key theory in understanding why students are dropping out of school [34]. Student engagement has also been defined as the active participation of students in academic and cocurricular or school activities, as well as a commitment to learning [35].

The authors in [36] added student engagement to three dimensions, namely cognitive engagement, behavioural engagement and affective engagement, and defined engagement behaviour as doing work and obeying rules. Affective engagement involves students' emotions and cognitive engagement combines motivation and the use of strategies. Therefore, student engagement is a multidimensional construct [37]. Various dimensions have been used by previous researchers in studies of student engagement, including: (1) affective engagement, behavioural engagement, and cognitive engagement [38]; (2) academic engagement, behavioural engagement, cognitive engagement, and psychological engagement [39]; (3) affective engagement, behavioural engagement, cognitive engagement, and agentic engagement [40]; (4) academical engagement, behavioural engagement, cognitive engagement, and affective engagement [41]; and (5) cognitive engagement, behavioural engagement, emotional engagement, and social engagement [42].

Each dimension of student engagement has been measured using different variables. The authors of [38] measured cognitive engagement using an in-depth learning strategy, surface learning strategy, and reliance; they measured behavioural engagement using students' attention and diligence while learning mathematics in the classroom; and they measured affective engagement using mathematics interest, exam orientation, frustration, and anxiety [38]. The author of [43] used student learning strategies, student views on group work, and values during mathematics learning to measure their respective cognitive, social, and emotional engagement [43]. The author of [13] used effort and perseverance in learning, as well as a sense of belonging, to measure behaviour and emotion engagement, respectively [13]. Although there are differences in the measurement of dimensions of student engagement, the ultimate goal is to measure students' responsibility. The goal is to identify meaningful learning and invest in students' learning as well as their future. Student engagement also encourages learning, requires energy and effort, is influenced by

many contextual influences, and can be achieved by all students. In conclusion, student engagement is related to students' efforts toward learning.

2.2. Student Engagement and Academic Achievement

Student engagement is a concept that can help teachers understand and improve the achievement of low-performing students [44]. In addition, student engagement in the classroom and school activities is important to improve academic achievement [45]. Past studies have proven that student engagement is a predictor of academic achievement [46–48]. Specifically, the relationship between student engagement and academic achievement has received attention from researchers from the past to the present [49,50].

Past studies have also distinguished the relationship between the dimensions of student engagement and achievement. The author of [51] reports that there is a significant relationship between cognitive engagement and student achievement. Specifically, student learning strategies that are a measure of cognitive engagement are related to achievement [52]. However, other studies have produced different findings [53].

Past researchers who have studied behavioural engagement have found that there is a significant relationship between behavioural engagement and academic achievement [54,55]. For example, diligence, which is a measure of behavioural engagement, has a bearing on academic achievement [56]. Diligent students' academic achievement is affected because they practice well and submit assignments [57]. This includes students' willingness to invest and strive in learning, while using the cognitive, metacognitive, and voluntary strategies needed to enhance their understanding [55]. Cognitive engagement is also said to have the strongest relationship with achievement when compared to behavioural and affective engagement [57].

Student affective engagement occurs when students have a sense of belonging to their school, feel like a part of the school and that the school environment is an experience in their lives [54]. Feelings of belonging to the school also influence students' desire to do assignments [58]. Furthermore, affective engagement is a value felt by students towards their mathematics subjects and math teachers [54]. Student affective engagement is significantly related to academic achievement [54]. This relationship is evidenced by good interactions between students and teachers; students who interact well with teachers achieve better results than students who do not interact well with their teachers [59].

In addition, affective engagement has been measured based on students' mathematical interests. Students who have a high interest in mathematics are able to obtain high achievement in mathematics examinations. The same is true for students who are examination-oriented, as this is also associated with obtaining good achievement [7,60]. However, some studies have found no relationship between mathematical interest and student achievement [55]. Based on discussions related to the relationship between student engagement and academic achievement, some studies report contrasting findings. Therefore, it is appropriate for this study to identify the relationship between student engagement and achievement in mathematics in the context of education in Malaysia.

3. Present Study

The lack of student engagement studies testing the dimensions of cognitive engagement, behavioural engagement, and affective engagement with the mathematical achievement of secondary school students in Malaysia prompted this study. Thus, this study focuses on student engagement dimensions, namely cognitive engagement, behavioural engagement, and affective engagement. The concept of cognitive engagement combines ideas from motivational research with ideas on the use of learning strategies, which contain surface strategies and deep strategies [51]. Students' dependence on teachers has also been identified as relevant [51,61,62]. However, studies identifying teacher dependence as a measure of cognitive engagement are very limited in the literature.

In terms of behavioural engagement, this study focuses on perseverance and attention in mathematics learning. Previous studies have identified a significant relationship between

perseverance, attention, and student academic achievement [63–65]. Therefore, affective engagement refers to students' mathematical interests as well as their examination orientation. It is undeniable that students' interest in mathematics influences their mathematical achievement [66–73]. Mathematics interest has a direct and positive effect on student mathematics achievement [66–73]; students who are interested in the subject will be involved in its learning. Students who have goals in examinations display a higher rate of improvement in academic achievement compared to those with no goals in the examination [74]. Testing student engagement based on cognitive engagement, behavioural engagement, and affective engagement is therefore expected to contribute to the improvement of mathematics achievement in Malaysia.

4. Materials and Methods

4.1. Sample and Data

Secondary school students from 227 schools in Selangor, Malaysia, made up the study's population. Using stratified random sampling, 1000 students were chosen to be the respondents of this study [75,76]. The selection of respondents from these schools was justified by the students' average performance as reported by the Ministry of Education. Furthermore, Selangor has the highest number of schools in the country with problematic students [77].

At the initial stage, 50 schools from 10 districts in the state of Selangor were identified for potential involvement in this study. Next, the school ratio to represent each district was identified and a total of 20 students became respondents for each school [76]. The sample is shown in Table 1.

Table 1. Study sampling.

District	Number of Schools Available	Percent	Number of Study Schools	Number of Students
Gombak	30	13	6	120
Hulu Langat	36	16	8	160
Hulu Selangor	14	6	3	60
Klang	33	15	7	140
Kuala Langat	13	6	3	60
Kuala Selangor	15	7	4	80
Petaling Perdana	44	19	10	200
Petaling Utama	26	11	6	120
Sabak Bernam	7	3	1	20
Sepang	9	4	2	40
Total	227	100	50	1000

4.2. Instrument

The instrument consisted of demographic factors such as gender, race and socioeconomic status which includes parent's academic background, occupation and parent's annual income. Students' mathematical achievement was measured using the year-end mathematical examination grades. Students' mathematics achievement grades were obtained through academic records kept by the class teacher. Meanwhile, student engagement in mathematics learning was measured using the Student Engagement in the Mathematics Classroom questionnaire of 57 items developed in [38], for which permission was obtained from the developer. The respondents' preferences were determined using a five-point Likert scale, with 1 indicating strongly disagree and 5 indicating strongly agree. The questionnaire was translated using the back-translation method, as proposed by Brislin [78]. After that, refinement of the questionnaire items was made based on the validity of the six experts. Three experts were experienced in mathematics education, one was experienced in measurement and evaluation and one had vast knowledge in language. All experts were educators with doctorate degrees.

Next, a pilot study was conducted with the involvement of 200 students from 10 schools. These schools were not included in the actual study. Data obtained from the pilot study were analysed for the purpose of determining the reliability of the questionnaire. This process is recommended when questionnaires are adapted from previous studies [79]. To ensure the accuracy of the analysis, data cleaning and screening procedures were applied to the Statistical Package for the Social Sciences (SPSS 23.0). Next, exploratory factor analysis (EFA) was conducted to deduce the underlying structure between the variables in the analysis [80]. Using Varimax rotation, items with communalities values less than 0.5 were removed, as suggested by Hair et al. [80], from the related constructs, which included cognitive engagement, behavioural engagement and affective engagement. Based on the EFA, 9 items were dropped from 20 items for cognitive engagement, only 6 items remained from 9 items for behavioural engagement and 3 items were removed from 21 items for affective engagement. Cognitive engagement had three factors, deep strategies, surface strategies and reliance, that indicated a good reliability value of 0.806. The behavioural engagement indicator with the highest reliability value of 0.864 was defined by attention and perseverance. Likewise, the affective engagement factor that had the same value of 0.864 was interest and exam orientation.

All these are supported by Garson [81], who suggests that an appropriate Cronbach's Alpha value to determine the validity of an internal consistency construct is 0.60 for exploratory purposes [80]. Significant values for the loading factors of the study variables were also confirmed.

Tables 2–4 show the reliability values of the study variables, the results of the analysis factors that have been conducted, and the variable and factor loading.

Table 2. Reliability values and factor loading for cognitive engagement.

Variables	Factor Loading			Cronbach's Alpha
	Deep Strategies	**Surface Strategies**	**Reliance**	0.806
CE11: I relate the things I learn in mathematics to the things I go through in real life	0.746			
CE2: I relate the things I learn in mathematics to other subjects	0.690			
CE8: I think about the things I've learned when I learn new things in mathematics	0.617			
CE3: I prefer to memorize all the formulas necessary to solve mathematics problems		0.837		
CE5: I find memorizing formulas is the best technique for learning mathematics		0.823		
CE4: I think the best way to learn mathematics is to try to do drills		0.510		
CE16: I learn mathematics based on what the teacher teaches			0.818	
CE17: I solve mathematics problems in the same way taught by the teacher			0.814	
CE15: I think the best way to learn mathematics is to follow the teacher's instructions			0.771	

CE = cognitive engagement.

Table 3. Reliability values and factor loading for behavioural engagement.

Variables	Factor Loading		Cronbach's Alpha
	Attention	**Perseverance**	0.864
BE1: I listen to the mathematics teacher's instructions attentively	0.802		
BE2: I participated in discussions during mathematics learning	0.748		
BE3: I focus when the mathematics teacher teaches in the classroom	0.734		
BE4: I am sure I will get the right answer if I keep trying to solve mathematics problems		0.780	
BE5: I try to use a different method if continue to not be able to solve the mathematics problem		0.693	
BE6: I try to understand if there is a problem in mathematics		0.671	

BE = behavioural engagement.

Table 4. Reliability values and factor loading for affective engagement.

Variables	Factor Loading		Cronbach's Alpha
	Interest	**Exam Orientation**	0.864
AE3: I am happy to learn mathematics	0.803		
AE1: I enjoy learning mathematics	0.801		
AE7: I love solving mathematics problems	0.798		
AE12: I feel happy when I get good mathematics results		0.835	
AE13: I am satisfied when I get good mathematics results		0.783	
AE12: I must work hard to get good mathematics results		0.711	

AE = affective engagement.

The Cronbach's Alpha reliability values of the cognitive engagement, behavioural engagement, and affective engagement variables shown in Tables 2–4 clearly confirm that this questionnaire has high reliability values.

5. Data Analysis

Data Preparation and Assumption of Correlation and Regression Analyses

Prior to data analysis, data preparation and statistical assumptions need to be made to ensure that the collected data are suitable for analysis [80,82]. Data preparation begins with checking for missing data. The results of the descriptive analysis showed that there were no missing data. Next, the process of identifying univariate, bivariate, and multivariate outliers was performed. Detection of univariate outliers was performed using graph methods, such as the boxplot. Detection of bivariate outliers was performed using graphs, such as the scatterplot. Mahanalobis distance was used to detect multivariate outliers. Although there were outliers in the data of this study, if they were not extreme, then the data were retained [80,82].

The data preparation process then included assuming normality using skewness and kurtosis values, as this condition is more convincing than visual inspection. Table 5 shows that the skewness and kurtosis values of the study variables are within the acceptable range of +1 [80], indicating that they are normally distributed.

Table 5. Skewness and kurtosis values of the study variables (n = 1000).

Variables	Skewness		Kurtosis	
	Statistics	Standard Error	Statistics	Standard Error
Cognitive Engagement	−0.726	0.077	−0.079	0.157
Behavioural Engagement	−0.392	0.077	−0.403	0.157
Affective Engagement	−0.730	0.077	−0.228	0.157
Mathematics Achievement	0.191	0.077	−0.921	0.157

The detection of multivariate normality and the linear assumption was conducted using the scatter diagram matrix method [80,83,84].

The next assumption is to check the multicollinearity between the study variables. First, multicollinearity was checked using Pearson correlation coefficients. If the correlation value exceeds 0.8, then it indicates there is multicollinearity between the variables [82]. Here, there was no multicollinearity between the variables because the correlation value was less than 0.8 (Table 6).

Table 6. Pearson correlation coefficient of relationship between cognitive engagement, behavioural engagement, affective engagement, and mathematical achievement.

Variables	Cognitive Engagement	Behavioural Engagement	Affective Engagement	Mathematics Engagement
Cognitive engagement	1			
Behavioural engagement	0.702 **	1		
Affective engagement	0.678 **	0.773 **	1	
Mathematics achievement	0.232 **	0.365 **	0.381 **	1

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

Multicollinearity screening was then performed using variance inflation factor (VIF). VIF determines whether a variable has a strong relationship with other variables. VIF values greater than 10 indicate that the variable has multicollinearity [82]. Determination of the tolerance value should also be performed because it is related to the IVF value. A good tolerance value is one that exceeds 0.2 [82]. The VIF and tolerance values indicate that there was no multicollinearity in the variables of this study (Table 7).

Table 7. VIF and tolerance values for variables.

Variables	Tolerance	VIF
Cognitive Engagement	0.457	2.190
Behavioural Engagement	0.358	2.793
Affective Engagement	0.374	2.677

6. Results

The profile of the study respondents was as shown in Table 8. The number of female respondents was 585 (58.5%), while the number of male respondents was 415 (41.5%).

Table 8. Study respondents.

Gender	N	%
Female	585	58.5
Male	415	41.5
Total	1000	100

Three dimensions of student engagement, cognitive engagement, behavioural engagement, and affective engagement, were studied to identify the relationship between student engagement and mathematical achievement, and to identify the predictors of student engagement that most influence mathematical achievement. Based on the Pearson correlation analysis, there was a significant relationship between student engagement and mathematical achievement (r = 0.415, $p < 0.05$). In addition, all correlations were significant between cognitive engagement (r = 0.232, $p < 0.05$), behavioural engagement (r = 0.365, $p < 0.05$), affective engagement (r = 0.381, $p < 0.05$) and mathematical engagement. All the relationships were statistically significant, yet at low levels.

Next, the results of the multiple regression analysis show that significant relationships between cognitive engagement, behavioural engagement, and affective engagement exist with students' mathematical achievement, as depicted in Table 9.

Table 9. Multiple regression analysis results.

Variable	Unstandardised Coefficients		Standardised Coefficients	t	*p*-Value
	Beta	Std. Error	Beta		
(Constant)	−0.722	0.334		−2.137	0.033
Cognitive engagement	−0.375	0.118	−0.135	−3.174	0.000
Behavioural engagement	0.585	0.116	0.244	5.057	0.000
Affective engagement	0.743	0.120	0.293	6.210	0.000

The results of the ANOVA regression analysis (Table 10) show a significant linear relationship between cognitive engagement, behavioural engagement, and affective engagement with mathematical achievement ($F_{(3,996)} = 68.991$, $p = 0.000$).

Table 10. ANOVA regression analysis.

	Sum of Squares	df	Mean Square	F	*p*-Value
Regression	352.167	3	117.389	68.911	0.000
Residual	1694.709	996	1.702		
Total	2046.876	996			

Table 11 shows a summary of regression models; all the factors studied contributed as much as 17.0% variance to mathematical achievement.

Table 11. Summary of regression models.

R	R Square	Adjusted R Square
0.415	0.172	0.170

Table 9 shows that affective engagement had the highest beta (β) value (0.743), followed by behavioural engagement (β = 0.585), and cognitive engagement (β = −0.375). The regression analysis equation is as follows:

$$\begin{aligned} \text{Achievement} = &-0.722 + 0.743\ \text{Affective Engagement} \\ &+ 0.585\ \text{Behavioural Engagement} - 0.375\ \text{Cognitive Engagement} \end{aligned} \quad (1)$$

This equation suggests that mathematical achievement will increase by 0.743 when affective engagement increases by one. Furthermore, an increase of 0.585 in mathematical achievement occurs when behavioural engagement increases by one. On the other hand, mathematical achievement will decrease by 0.375 when cognitive engagement increases by one.

7. Discussion

This study determined the relationship, using a multidimensional construct of student engagement, among cognitive engagement, behavioural engagement, affective engagement, and mathematical achievement. The largest predictor of the student engagement dimensions that influence mathematical achievement was also determined. We addressed this objective in the context of student engagement in mathematics learning using a questionnaire adapted from 38]. This study was conducted with secondary school students in Selangor, Malaysia. The process of translation, expert validation, and exploratory factor analysis was performed to ensure the suitability of the study in the Malaysian context. Assumptions of multiple regression analysis were also performed.

The results of the study show that there was a significant relationship between each variable—cognitive engagement, behavioural engagement, and affective engagement—and the mathematical achievement of secondary school students. Specifically, positive relationships between behavioural engagement and affective engagement with mathematical achievement were found, and a negative relationship between cognitive engagement and mathematical achievement was established. These results are very important for the field of mathematics education at the secondary school level in Malaysia. This study explains that student engagement in mathematics learning is a key factor in students' mathematical achievement. Increased affective and behavioural engagement can improve students' mathematical achievement, although the opposite is the case for cognitive engagement. These results are contrary to previous studies [14,85].

The positive relationship between behavioural engagement and mathematics achievement indicates that students' attention and diligence in mathematics learning are critical [86]. These results indicate that students' attention and diligence during mathematics learning can improve their mathematics achievement. Students who pay attention and display diligence in learning obtain high academic achievement, while students who do not pay attention and are not diligent in learning obtain low academic achievement [87]. Diligent students make efforts to solve mathematical problems to succeed. They try to understand the questions and attempt various strategies to obtain the answers. This behaviour occurs when students have the motivation to learn. Thus, teachers can increase student motivation by using teaching strategies which utilise technology [87]. Affective engagement is positively related to students' mathematical achievement, which informs students' interest in mathematics [66] and examination orientation [8]. However, there are studies that report no significant relationship between students' interest in mathematics and mathematics achievement among high-achieving students in Malaysia; in contrast, such a relationship exists for low-achieving students [73].

This study also finds that there is a negative relationship between cognitive engagement and students' mathematical achievement. This means that students' learning strategies and students' dependence on teachers have a negative impact on their mathematics achievement. Thus, students should use the right learning strategies, be they deep strategies or surface strategies, and should reduce dependence on teachers, to improve their mathematical achievement. Although there are studies that show that deep strategies can improve students' academic achievement, there are also studies that find that there is no significant relationship between deep strategy and mathematical achievement [8].

The second objective of this study was to determine the largest predictor among the student engagement dimensions that influenced the mathematical achievement of secondary school students. Affective engagement was found to be the largest predictor determining the mathematical achievement of secondary school students. These findings contrast with the results of previous studies which report cognitive engagement as being a major predictor of mathematical achievement [14,85]. The affective engagement factors that were the greatest predictors of mathematics achievement were mathematics interest and exam orientation. This shows that in mathematics learning, interest and exam orientation are very important. Students' interest in mathematics is important because it provides motivation for students to learn mathematics and improve their achievement. Interest and

motivation move simultaneously in influencing academic achievement [88]. Interest also affects the ways students learn to improve their mathematics achievement [66]. Therefore, it is crucial to increase the level of interest in mathematics so that mathematical achievement can be improved [71]. Furthermore, students not having goals in exams are negatively impacted in terms of their academic achievement [74].

Since students' interest in mathematics and exam orientation were the biggest factors influencing mathematics achievement, mathematics teachers need to take the initiative to use teaching strategies that can encourage such interest [69]. Teachers can also increase student engagement by adopting heterogenous pedagogical approaches [54]. Therefore, teachers cannot continue the teacher-centred learning method that is still common practice in Malaysia [77]. Efforts to increase student engagement need to be taken seriously because student engagement in mathematics learning in Malaysia remains at a moderate level [85].

Cognitive engagement from learning strategies and dependence on teachers lowered students' mathematical achievement. Thus, in mathematics learning, students must identify appropriate learning strategies and not adopt a teacher-dependent culture. In fact, students' dependence on teachers influences their learning strategies. Students who practice learning strategies in depth will improve their mathematics achievement [57]. In-depth learning strategies require students to understand the concepts found in mathematics and be able to connect mathematics learning with the real world. Skills such as these are important for students to prepare for the future. This also has to do with high order thinking skills (HOTS). Therefore, the Ministry of Education (MOE) Malaysia launched the HOTS programme in an effort to improve students' thinking skills. The results of this study indicate the importance of HOTS programmes conducted in schools in Malaysia. Again, it is suggested that, in order to improve mathematics achievement, teachers must reduce the teacher-centred approach to teaching reported as commonplace by the MOE.

8. Implications

In carrying out this study, several problems were faced by the researchers. The main problem faced was a limitation in distributing the questionnaire to and implementing it with respondents. This was due to the recent COVID-19 outbreak. In order for respondents to complete the questionnaire, the researchers gave them two weeks. The researcher also instructed the teachers in charge and school administrators on how to administer the questionnaire. This action was implemented so that students could understand the purpose of this study based on the information obtained. Furthermore, students must have a thorough comprehension of higher-order thinking skills (HOTS), as demanded by the policy makers. Such review must take into account those implementing HOTS at the school level. Immediate action is needed so that more appropriate and practical methods can be carried out according to the needs of students in Malaysia. Perhaps future studies can focus on the aspect of cognitive engagement of students from the aspect of independence from teachers and the use of deep-learning strategies only. This would enable the accurate identification of the success or failure of the HOTS programme introduced by the MOE. Future studies are necessary to ascertain whether Malaysia is on track to achieve the quality aspirations in the Malaysia Education Development Plan (MEDP) 2013–2025 to place Malaysia in first-to-third position in international assessments such as PISA. A qualitative method is also recommended for future relevant investigations, as more information can be collected from teachers and students. Thus, interviews and observations could be applied to better understand the reality of students' engagement in class.

9. Conclusions

This study reveals a positive relationship between student engagement and mathematical achievement. To be specific, there is a significant positive relationship among behavioural engagement, affective engagement, and mathematical achievement that leads to affective engagement being the largest predictor, based on the multiple linear regression analysis.

This indicates that students' interest in mathematics and exam orientation influenced mathematics achievement. Thus, both of these factors must be enhanced to improve students' performance in mathematics. Students should have fun and feel happy when learning mathematics, to experience a positive impact on their affective engagement. Students also need to have clear targets in the exams so that they are better prepared when facing them. Support from teachers, peers, and family is required to make them better at and have a good perception of mathematics. Researchers should not merely focus on cognitive engagement in learning mathematics; affective and behavioural engagement are also important factors. All three factors work together to make learning mathematics more meaningful.

This study helps policy makers by channelling information on the effectiveness of the programmes that have been conducted. The study also provides clear information to policy makers and implementing groups on the importance of increasing students' affective engagement in an effort to improve their mathematical achievement, especially from the aspects of affective and behavioural engagement. The contributions to the literature on the study of mathematics achievement based on student engagement factors are of importance in Malaysia. The contribution to administrators and teachers in schools is that they need to be sensitive to the cognitive engagement of students. Appropriate action should be taken to increase student engagement in learning, especially affective engagement. Affective engagement involves emotions and feelings, so administrators and teachers are responsible for creating a conducive environment to support students' interest in mathematics learning to reach high levels. As a result, despite the fact that mathematics primarily focuses on cognitive engagement, it can be challenging for teachers to ensure that affective engagement and behavioural engagement are important.

Author Contributions: Conceptualisation, M.M., S.M.M. and Z.H.I.; methodology, M.M., S.M.M. and Z.H.I.; software, M.M.; validation, M.M., S.M.M. and Z.H.I.; formal analysis, M.M.; investigation, M.M.; resources, M.M.; data curation, M.M.; writing—original draft preparation, M.M.; writing—review and editing, M.M. and S.M.M.; supervision, S.M.M. and Z.H.I.; project administration, M.M., S.M.M. and Z.H.I.; funding acquisition, S.M.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all the subjects involved in the study.

Data Availability Statement: Not applicable.

Acknowledgments: This research was supported by a grant from the Faculty of Education, Universiti Kebangsaan Malaysia; GG-2020-026.

Conflicts of Interest: The authors declare no conflict of interest.

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