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A Relationship Between Secondary And Tertiary Mathematics Grades: A Case Study For Foundation Students

(Hubungan Antara Gred Matematik Menengah Dan Tertiari: Satu Kajian Kes Untuk Pelajar Asas)

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ABSTRACT

The achievements of students in mathematics or any mathematics course at the higher education level have declined in recent decades, even after the release of the Covid-19 pandemic. The purpose of this quantitative study is to determine the relationship between the Malaysian Certificate of Education (SPM) Modern Mathematics and Additional Mathematics grades and passing a high-level mathematics course at a university. The case study was conducted on 179 foundation-level of National Defence University of Malaysia (UPNM) students who enrolled in courses requiring knowledge of mathematics. Grades for SPM Modern Mathematics and SPM Additional Mathematics were collected using a checklist that students filled out. The dependent variable is measured by the results of the end-of-semester examination for the mathematics course. Descriptive analysis and correlation tests were conducted in this study. From the initial prediction, we may conclude that students with high marks in high school subjects will likewise perform well in their tertiary studies. Nonetheless, the correlation test reveals that it is not particularly significant. There is no conclusive evidence of the correlation between SPM Modern Mathematics grades and tertiary mathematics course performance. Considering this, a comparison of the data between SPM Additional Mathematics grade and tertiary mathematical topics revealed a positive association between the two. However, the correlation between SPM Mathematics and tertiary mathematics is relatively weak, with a Pearson correlation of 36.3%. Specifically, the achievement of mathematics subjects in the foundation level is less likely to be affected by SPM Modern Mathematics and SPM Additional Mathematics achievement.

Keywords: SPM Modern Mathematics, SPM Additional Mathematics, Mathematics, student achievement, tertiary level

ABSTRAK

Pencapaian pelajar dalam bidang matematik atau mana-mana kursus matematik di peringkat pengajian tinggi telah menurun dalam beberapa dekad kebelakangan ini walaupun selepas penularan pandemik Covid-19. Tujuan kajian kuantitatif ini adalah untuk menentukan hubungan antara subjek Matematik Moden SPM dan Matematik Tambahan SPM bagi Sijil Pelajaran Malaysia (SPM) serta kursus matematik di peringkat yang lebih tinggi iaitu di universiti. Kajian kes ini telah dijalankan ke atas seramai 179 orang pelajar peringkat asasi di Universiti Pertahanan Nasional Malaysia (UPNM) yang mengikuti kursus-kursus yang memerlukan pengetahuan matematik. Gred bagi Matematik Moden SPM dan Matematik Tambahan SPM dikumpulkan menggunakan senarai semak yang perlu diisi oleh pelajar. Pembolehubah bersandar yang diukur adalah keputusan peperiksaan akhir semester untuk kursus matematik. Analisis deskriptif dan ujian korelasi telah dijalankan dalam kajian ini. Dari ramalan awal, kita dapat menyimpulkan bahawa pelajar yang mempunyai markah tinggi dalam mata pelajaran Matematik ketika di sekolah menengah juga akan menunjukkan prestasi yang baik dalam pengajian tinggi mereka. Walau bagaimanapun, ujian korelasi menunjukkan bahawa ia tidaklah begitu ketara. Tiada bukti konklusif terdapat hubung kait di antara gred Matematik Moden SPM dan prestasi kursus Matematik di peringkat tertiari. Dengan mengambilkira perkara ini, perbandingan data antara gred Matematik Tambahan SPM dan gred matematik di peringkat tertiari menunjukkan hubungan positif antara kedua-duanya. Walau bagaimanapun, hubungan korelasi antara Matematik Moden SPM dan matematik tertiari agak lemah, dengan nilai kolerasi r sebanyak 36.3%. Khususnya, pencapaian mata pelajaran Matematik di peringkat tertiari kurang dipengaruhi oleh pencapaian Matematik Moden SPM dan Matematik Tambahan SPM.

Kata Kunci: Matematik Moden SPM, Matematik Tambahan SPM, pencapaian pelajar, peringkat pengajian tinggi

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INTRODUCTION

Mathematics has long been considered an indispensable discipline, given that arithmetic and logic are the basic principles of science and technology. Subsequently, educational authorities encourage computational and problem-solving expertise among students. Students entering colleges and universities or institutions of higher education were shown a high level of respect but were treated differently from those in secondary education. Since they were engaged in acquiring knowledge independently, the outcomes should be indicative of their level of expertise. Recently, there has been contention among teachers because students are struggling even in their first year of college. This raises serious concerns about students' entry qualifications and raises the question of whether or not there is any evidence that education systems that permit substantial heterogeneity between schools perform differently at the tertiary level (i.e., either better or worse) than education systems with little differentiation between schools (Michaelowa, 2007). Furthermore, the presence of a considerable proportion of low-achieving students is most likely attributable to teacher-led instruction, which continues to dominate mathematics classrooms in most Asian nations (Yeh et al., 2019). Students of various socioeconomic backgrounds may use factors such as teacher-student interactions and academic drive to predict whether or not they will drop out of school (Bergeron, 2011). Particularly, strong mathematical competence beliefs predicted low dropout intention in students from high socioeconomic status.

Mathematics course is a prerequisite in almost every field of study, especially those associated with science and technology, and students are required to learn mathematics before they embark on their chosen line of employment. In particular, mathematics courses are not only important in every aspect of teaching and learning, but they are also important in career pathways. According to the findings of their study, Shaari et al. (2016) discovered a long-term beneficial relationship between higher education and the unemployment rate. There won't be a link between education and unemployment, though, if the linkage is temporary. Understanding the basics of numerical and computation has been introduced from an early level and continuously necessitated until higher education. Furthermore, overall quality management in elementary and secondary education is critical to enhancing the standard of a country's educational system (~~Eleni~~ Sfakianaki.et al., 2021). It is critical to highlight two major psychological aspects in the achievement of Mathematics subject, namely student involvement and perceived academic ability (Akey, 2006).

At a higher level of study, branches of mathematics are introduced to students depending on their area of programme chosen as requirements for final year research projects, theses, and papers. Despite all the important aspects of mathematics, there has been a deterioration in the achievement of marks in this subject. Various findings on the measurement correlation between high school grades and university performance (Cyrenne et al., 2012; Hatta & Muhti, 2017) and the research indicate different outcomes following their respective context and samples. Heidi et al. (2004) investigate the long-term impacts of secondary school on educational choices after high school and subsequent results in higher education. On both outcome variables, multilevel logistic regression models revealed substantial long-term impacts of secondary education. There are indications that the impacts are mediated by the degree of student's success at the completion of secondary school.

Eng et al. (2010) study the relationships between the factors impacting the course grades of underachieved Mathematics courses. Pre-Calculus, Calculus I, Mathematics II, and Engineering Mathematics I were classified as underachieved mathematics courses based on the findings. SPM Additional Mathematics had the greatest influence on Pre-Calculus, and it was also a significant predictor of the course grades of poorly performed Mathematics courses. Prior to the study, it was determined that female students outperformed male students in all subjects assessed. This report concludes with recommendations for improving the present state of mathematics education. Furthermore, Husnira et al. (2018) used regression analysis and determined that there is a significant positive correlation between SPM Mathematics achievement and achievement of Engineering Mathematics 2 course in polytechnics. This reveals that SPM Additional Mathematics is one of the means by which students excel in Engineering Mathematics 2 at polytechnics.

More sophisticated study by Hasan et al. (2018) showed that there were decreasing number of students from Malacca, a city on the Peninsular Malaysia, taking additional mathematics at the SPM level from 2012-2016. They noticed that the chances of the local university in Malaysia of getting the right candidate for STEM courses were at risk. The researcher employed the fish bone technique to examine the hypothesis that smart secondary school students will become smart university undergraduates in mathematics and surprisingly findings revealed that smart students at the SPM level do not always turn out to be smart in university for Mathematics courses. On the other hand, Nor et al.

(2019) found that there is a continuation of knowledge and mathematical skills for SPM Mathematics, Engineering Mathematics 1, 2, and 3. Accordingly, students need to master all the basic math skills to enable them to get an excellent score in mathematics at the next level. Reviewing prior research undertaken to evaluate student accomplishment and attempts and discovered if virtual or conventional settings impact the academic performance of students in a virtual environment, this article reviews previous research conducted to assess student achievement. The results of a case study by Žnidaršič et al. (2022) suggested that pandemic measures had no significant effect on the mathematical achievement of social sciences students in Slovenia. Daniel (2021) investigates the disparities between pre- and post-COVID-19 pandemic mathematics grades, focusing on the potential variations between midterm and final marks in Italy. It cannot be ruled out that the accomplishments of such students are overstated, as shown by the data. Grades that do not accurately reflect students' real knowledge and abilities, might provide educators and policymakers with inaccurate or even fraudulent information about the quality of distant learning and students' understanding.

Other investigation on factors affecting the academic performance of students, Muhammad et al. (2021) conducted research on secondary school students in a Gilgit-Baltistan district and identified a correlation between academic performance and critical thinking (CT). Researchers found that female students, those attending rural schools, and those affiliated with the scientific group all had slightly higher critical thinking compared to males, attending urban schools, and those affiliated with the arts group. Besides, a weak positive correlation between critical thinking and academic achievement was discovered. Previous research showing a favourable correlation between these factors was supported by our findings. The correlations between critical thinking and academic achievement were likewise found to be weak or notably weak. Inconsistencies between this study and other studies may be explained by the differences in the sample populations collected in this current institution. The study discovered a divergence between critical thinking and academic accomplishment. The use of mixed methodologies (structural equation modelling and grounded theory) results in a comprehensive study by Sethi et al. (2020) for the first time, elucidates how many developmental relationships in young people's lives influence their connection to and success in school from a broad as well as a more specific, practice-oriented perspective. In Study 2, the research team decided to take a qualitative look at how teachers create relationships with their students that motivate them as well as how students perceive those relationships as a result of the findings from Study 1, which demonstrated the central significance of teacher-student relationships on student motivation. Study 2 employed student focus groups and a grounded theory, open coding approach to analysis to find recurring themes characterising what teachers did that, in students' opinions, worked well to forge close bonds with students and increase their enthusiasm for academic work.

The present study investigated the relationship between SPM Modern Mathematics and SPM Additional Mathematics and the accomplishment of marks in mathematics during their first semester in foundation (pre-university) programmes. The sample was collected from students who had an online learning environment due to the Covid19 pandemic before enrolling in the foundation programme. The current study's findings are critical in understanding the causes for students with low performance in higher learning mathematics subjects.

RESEARCH OBJECTIVE

The objective of the study is to determine whether there is an association between SPM Mathematics grade and mathematics grade during their pre-university program.

For this reason, the present study aims to answer the following research hypothesis:

H1. Is there any statistically significant difference between mean score for SPM Modern Mathematics and mean score for Mathematics I during foundation.

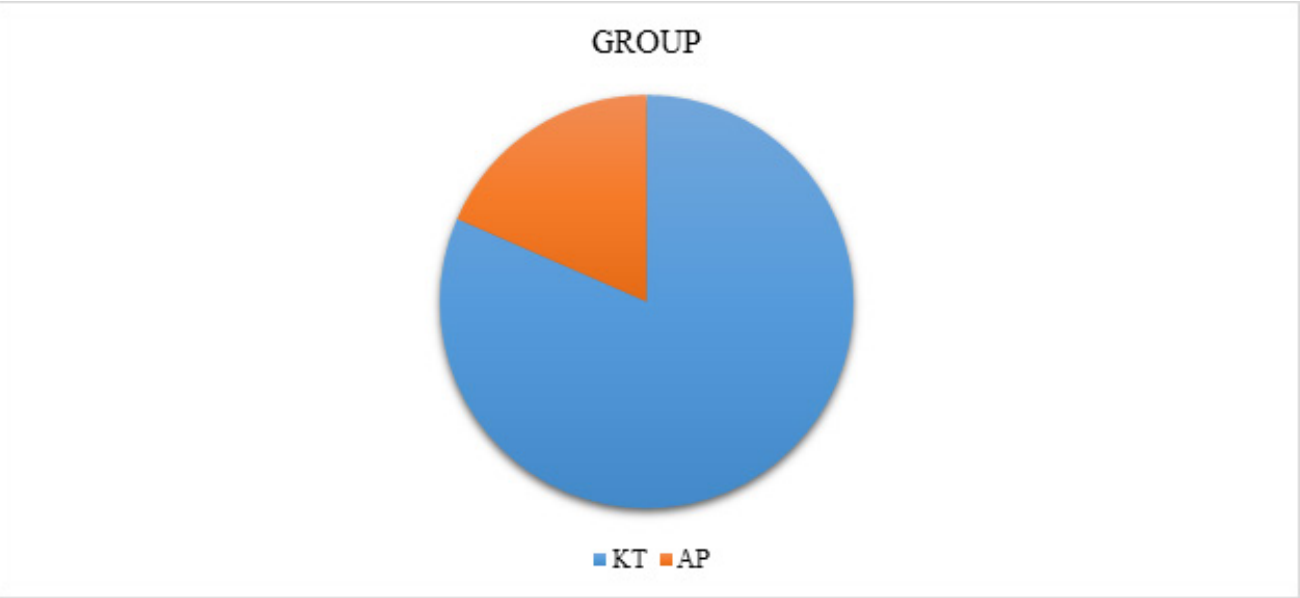
H2. Is there any statistically significant difference between mean score for SPM Additional Mathematics and mean score for Mathematics I during foundation.

METHODOLOGY

Method

Participants. The study had 179 participants, representing 78% of the foundation-level students from Engineering Science (KT) and 18% from Medical Science (AP).

Procedure. The study involved the collection of data from 179 students for foundation program, who took the subject of Mathematics course in their first semester of academic study. SPM Modern Mathematics and



SPM Additional Mathematics grade during SPM were taken regardless of what high school they attended for the purpose of descriptive analysis. It is classified according to grade performance. Table 1 displays the grade used for SPM Modern Mathematics and SPM Additional Mathematics.

TABLE 1. Grade for SPM Modern Mathematics and SPM Additional Mathematics

Category	SPM result for Modern Mathematics/ Additional Mathematics
1	A- to A+
2	B to B+
3	C to C+
4	D to E
5	G (Failed)

Scores for Mathematics subjects are also classified according to grade performance. Table 2 below is a scoring grade used for Mathematics subject at the foundation level.

TABLE 2. Grade for Mathematics I

Category	Result for Mathematics I
1	A- to A+
2	B- to B+
3	C- to C+
4	D- to D
5	E (Failed)

Analyses. Descriptive analysis is used to compare achievement levels between the SPM and university level. Next, the correlation test is carried out to measure the strength of the linear relationship between

SPM Mathematics and Mathematics subject in higher education. Following that, conclusions were drawn that validated the following study hypothesis.

H1. Is there any statistically significant difference between mean score for SPM Modern Mathematics and mean score for Mathematics I during foundation.

H2. Is there any statistically significant difference between mean score for SPM Additional Mathematics and mean score for Mathematics I during foundation.

RESULTS AND DISCUSSIONS

Participants. This study involved students from a Mathematics 1 course during their first year at a foundation program, UPNM. Due to the Covid-19 pandemic, the students who were chosen did not get formal teaching in a traditional classroom setting, but instead learned remotely (through online learning). 74% of the 179 participants were male, while the remaining 24% were female. The majority (74%) were Malay, with the rest comprising Indian (16%), Chinese (4%), and other (6%).

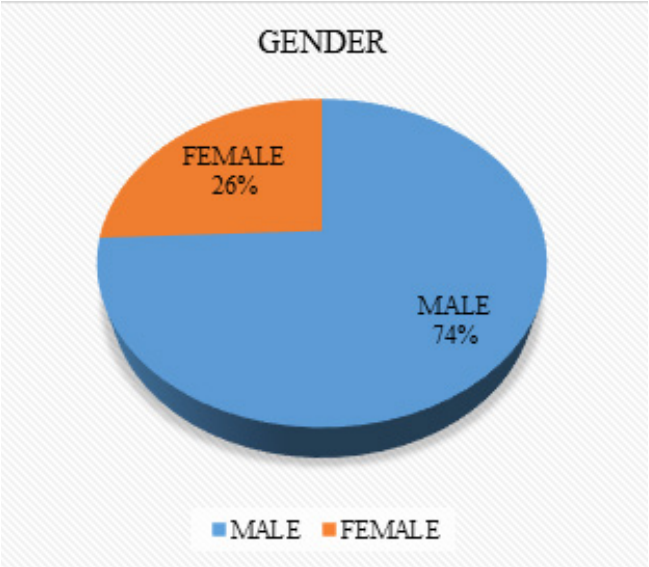


Figure 1. Gender

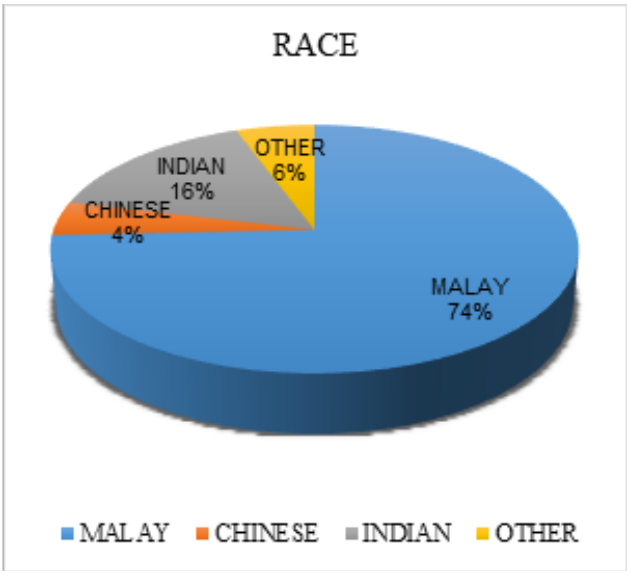


Figure 2. Race

TABLE 3. Grade Mathematics subject by frequency

Grade	SPM Modern Mathematics	SPM Additional Mathematics	Mathematics I
A+	100	8	6
A	77	46	40
A-	2	32	18
B+	0	32	38
B	0	19	33
B-	0	0	25
C+	0	15	8
C	0	11	6
C-	0	0	0
D+	0	0	3
D	0	16	0
D-	0	0	2

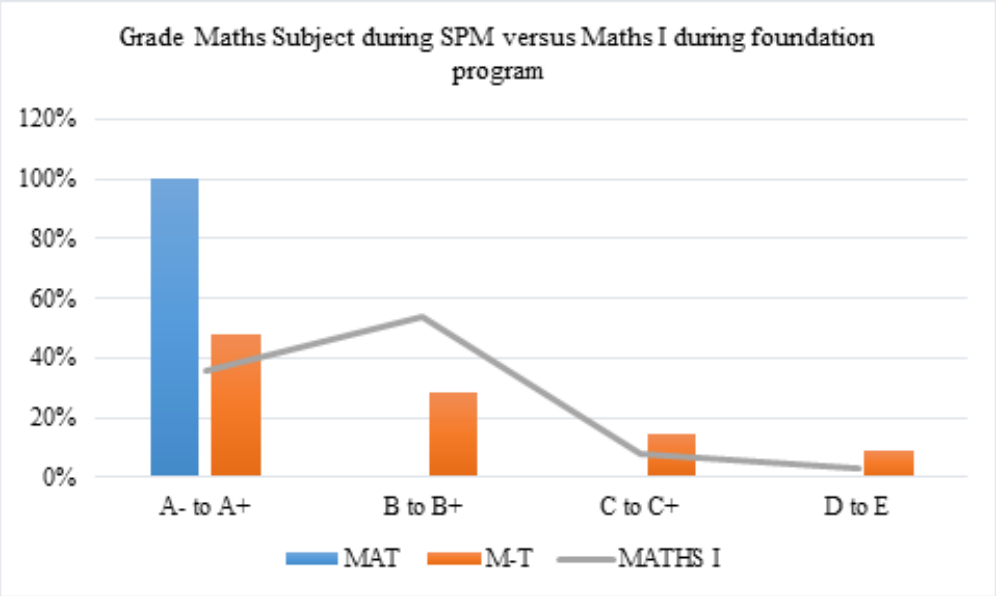


FIGURE 3. Histogram and line graph for mathematics performance comparison between SPM Modern Mathematics (MAT), SPM Additional Mathematics (M-T), and Mathematics I (MATHS I)

Table 3 and Figure 3 show the frequency of students' grades for each variable i.e. SPM Modern Mathematics, SPM Additional Mathematics and Mathematics I respectively. The overall results of SPM Modern Mathematics achievements were outstanding, with 100% of students receiving grade A. For SPM Additional Mathematics subject, 49% students obtained A- to A + and followed by 28% students received B+, B and B- grades. In addition, a percentage of 14% students who get grades C+ and C signifies that students did not excel on Additional Mathematics during SPM level. In comparison to students' results of Mathematics I during their first year study at university shows that the percentage of students score excellent results (A+ to A-) were dropped significantly contributed by 35% (Table 4). Majority (53%) falls within the grade ranging from B- to B+ grades. This is followed by 7% of students achieving a C in Mathematics subject and 3% of students performing poorly (D+ to D-) in Mathematics.

TABLE 4. Frequencies of students in each Mathematics grades.

	SPM Modern Mathematics		SPM Additional Mathematics		Mathematics I	
Grade	n = 179	%	n = 179	%	n = 179	%
A+	100	56%	8	4%	6	3%
A	77	43%	46	26%	40	22%
A-	2	1%	32	18%	18	10%
B+	0	0%	32	18%	38	21%
B	0	0%	19	11%	33	18%
B-	0	0%	0	0%	25	14%
C+	0	0%	15	8%	8	4%
C	0	0%	11	6%	6	3%
C-	0	0%	0	0%	0	0%
D+	0	0%	0	0%	3	2%
D	0	0%	16	9%	0	0%
D-	0	0%	0	0%	2	1%

TABLE 5. t-Test: Paired two sample for means

	SPM Additional Mathematics	SPM Modern Mathematics	Mathematics I
Mean	3.206704	4	3.273743017
Variance	0.895236	0	0.424643776
Observations	179	179	179
Pearson Correlation	0.363297	-	
df	178	178	
$t\ stat$	-0.96056	14.91092052	
$P(T <= t) One - Tail$	0.169038	1.87291E-33	
$t\ Critical\ One - Tail$	1.653459	1.653459126	
$P(T <= t) Two - Tail$	0.338076	3.74582E-33	
$t\ Critical\ Two - Tail$	1.973381	1.973380889	

The data was further analyzed to determine the relationship between the SPM Modern Mathematics grade and their corresponding Mathematics I grade during their foundation programme at university. The data was converted from categorical i.e. classes of A, B, C grades respectively into interval using a numerical scale of A = 4, B = 3, C = 2, D = 1, F = 0. The output in Table 5 shows that the mean for SPM Modern Mathematics is 4 and the mean for SPM Additional Mathematics is 3.21 while the mean for Mathematics I is 3.27. The variance of each variable is not assumed to be equal based on the test statistics. We cannot reject the null hypothesis because our p-value (0.338076) is greater than the standard significance level of 0.05. The hypothesis that the population means differ is not supported by our sample data. In particular, the mean score for Mathematics I exceeds the mean score for SPM Additional mathematics mean. On the other hand, the test results indicate a statistically significant difference between the mean score of Mathematics I at the end of the first semester and those of SPM Modern Mathematics mean score with p-value = 0.000 (p <0.05). In addition, the strength of the linear relationship between SPM Additional Mathematics grade and Mathematics I grade show a weak relationship with Pearson correlation, r = 36.3% indicating the variables have low correlation (p>0.05).

CONCLUSION

The results of this study concluded that the score of SPM Additional Mathematics is positively correlated to the Mathematics 1 grade but with a low correlation level. However, the association between the two variables are insignificant contributed by the greater p-value (p>0.05). The relationship between SPM Modern Mathematics and Mathematics I is statistically significant (p< 0.05). The study sample, which was only 179 students and only included students taking Mathematics I during their foundation programme at the university level, is most likely the reason for the differences in the means of the two subjects. However, it is possible that this relationship is only related to a few students who score higher in Mathematics in comparison to their SPM grade. Undoubtedly, there are students who are continuously striving to improve their basic knowledge of Mathematics in order to successfully correct their weaknesses from time to time. There are also students who excel during SPM but perform poorly while entering to a higher level. All the causes and challenges might happen due to unconducive learning environment, shifting from normal classroom to virtual learning and other factors such as student engagement, student attitudes, teaching methods of teaching staff and parental encouragement. This study should be further investigating the intrinsic and extrinsic factors that are directly influenced by both students' and parents' perspectives. In addition, it is crucial to understand how students' relationship with their lecturers, parents, and friends may differently affect their academic experience and performance as suggested by Sethi, et al. (2020). The findings of this study are important for the Ministry of Education to further strengthen the Mathematics curriculum in primary and secondary schools, as the transition of education from school to university, particularly for Mathematics subjects, should be viewed as the primary route and specific aspects of the transition process should be studied. Furthermore, improvements to

the curriculum must be refined by examining various domains.

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