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# Empirical Study on Attitude towards Making Decision to Select Mathematics for First-Degree Program

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Recently debatable arguments have existed regarding the perceived lack of numerical skills among the graduates from the Humanities and Social Sciences. In response to this concern, the Faculty of Humanities and Social Sciences, Faculties of Art in national universities in Sri Lanka have taken measures to more opportunities to undergraduates to bolster their numerical proficiency. This is achieved through the incorporation of mathematics course units for their degree programs along with the main subject streams. The study focuses on factors that affect the undergraduates' attitudes towards making the decision to select the subject mathematics for their first-degree program. A sample survey was carried out using structured questionnaire and stratified random sampling technique was utilized to select a sample size of 352 from the undergraduates belongs to Faculty of Humanities and Social Sciences in University of Sri Jayewardenepura. The binary logistic regression model is utilized, and the study revealed that self efficacy, mathematical anxiety, and interest in mathematics are significantly affected students' attitudes on counting mathematics course units for their degree program. The student who has self-efficacy is 1.03 times more likely to select mathematics course unit at the first academic year than other students. A unit increase of mathematics anxiety with all other factors remaining constant, the odds of a student selecting the mathematics course decreased by 11.2%. When one-unit increases in the interest in mathematics of students the odds of selecting mathematics course unit is 1.06 times more likely to than other peers. These insights suggest that educational institutes, particularly those in the humanities and social sciences, should prioritize enhancing students 'numerical skills. This can be achieved by providing valuable consideration aimed at refining their curriculum and support mechanism, increasing awareness programmes about the importance of studying mathematics course units within their degree programmes and conducting programmes to reduce mathematics anxiety while fostering an increased interest in mathematics.

Keywords: anxiety, binary logistic regression, mathematics, odds ratio, undergraduate

## INTRODUCTION

The educational landscape in Sri Lanka mandates that students must undertake the General Certificate of Education (G.C.E) Ordinary Level (O/L) Examination upon completion of 11 years of schooling. Mathematics is a compulsory subject they must pass to qualify the G.C.E. (A/L) Examination. Subsequently, students are required to sit for the G.C.E. Advanced Level (A/L) Examination to gain admission to the national universities in Sri Lanka. Typically, students in the Art stream do not engage

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in numerical course works until they enrol in the university system. Consequently, their numerical skills may decline over the time span of approximately three years.

A graduate with proficient numerical skills contributes directly or indirectly to the betterment of society as whole. Many graduates from the faculty of Humanities and Social Sciences pursue diverse professions such as teaching, admirative roles, development works, banking, executive positions etc. However, arguable comments have recently emerged regarding the perceived deficiency in numerical skills among the graduates from the Humanities and Social Sciences. To address this issue most of the Arts and Humanities and Social Sciences faculties of National Universities in Sri Lanka incorporated mathematics course units to their curriculum to enhance and strengthens the numerical skills of their undergraduates. However, many students who are pursuing a Bachelor of Arts Degree still exhibit an indisposition to include mathematics as a subject in their academic program. In point of view, the research question raised that what are the real factors that influence to undergraduate in making decision to choose mathematics for their degree programme. The decision-making process regarding subject selection for their degree program becomes more student-centred upon university enrolment. Thus, it is noticeable a significant percentage of students who enrol for this degree program are hesitant to follow mathematics courses due to many reasons. Thus, the main objective of this research is to identify the factors that affect undergraduates' attitudes toward the decision of selecting mathematics for their degree program. Besides, this study focusses on exploring the reasons which affect students in social science for not selecting mathematics as a subject for their degree. this research provides a more comprehensive overview and emphasizes the need for a more thorough investigation into decision-making process related to subject selection in higher education.

***Literature Review***

Studying mathematics is a prerequisite for the development of an individual's numerical skills. According to Setiawan et al., (2022) the mastery of mathematics skills plays a crucial role for students. Silva and Banneheka (2011) claimed that the importance of identify the factors affect result of mathematics to reduce the failure rate in mathematics at the G.C.E. (O/L) examination in Sri Lanka. Deuren and Santema (2012) claimed that it is a difficult challenge making higher education decisions for the students in the complex decision-making landscape. In particular, many higher education options can be characterized as multi-attribute decision-making problems. Within this complex decision-making context, numerous alternatives present themselves, each defined by a set of attribute values and these values reflect each option meets the objectives of the student as a decision-maker. According to Streveler et al., (2010), it is difficult to attract and educate future workers if students fail to identify their future aims, objectives, and criteria during the decision-making process. However, the decision-making process itself demands the selection of a future course of action from a spectrum of options, each associated with a distinct set of predicted consequences, as outlined by Babad and Tayeb (2003). In terms of student choice decisions, there is growing research interest in understanding how students, in their role as consumers, cross the process of selecting higher education options. A previous study was done by Naidoo (2011) addressed the measures that students should undertake when making decisions about higher education. This study outlined a multi-phase process, starting with problem identification, where students recognized the necessity of deciding on their educational journey. In the second phase, students actively seek information on issues that they feel are relevant to their decision-making. The acquired information becomes instrumental in the third stage of decision making, during which alternatives are evaluated based on the gathered data. Following the above evaluations, a final choice is reached and implemented by applying to the selected program. Students should be aware about the importance of the learning mathematics. Mathematical skills, including problem -solving, logical reasoning, and quantitative analysis, are fundamental components of critical thinking. Engaging in mathematical tasks and problem-solving activities direct to enhance critical thinking ability Basri et al., (2019).

Newman and Jahdi (2009) highlighted the increasing influence of marketization in higher education, emphasizing the adaptation of socio-economic theories within this context. The market- based concept places a significant emphasis on student choice behaviour as a crucial point in higher education. Previous studies on students' attitudes towards mathematics and how those attitudes affect their mathematics achievement were also discussed. Singh et al.,(2010) conducted a study examining the impact of interrelated factors namely, motivation, attitudes and the time allocation to academic endeavours in Mathematics and Sciences courses. Their finding led to the suggestions of designing curricula aimed at bolstering interest in Mathematics and Science. Moreover, they proposed, the students' implicit decisions about pursuing or avoiding Mathematics causes determined by earlier success of those causes. Also, they emphasize the importance of the interrelated factors which take into account success in Mathematics and Science achievement. The level of Mathematics studied in secondary school is also important for success in university Mathematics courses (Nicholas et al., 2015). As per Kajander and Lovric (2005) the amount of time students dedicates to learning mathematics in their final years of high school is significantly correlated with their performance in a first year Mathematics course. Research conducted by Tapia (2004) suggested that self-confidence, Mathematics value, Mathematics enjoyment, and motivation are important variables to investigate students' attitudes toward mathematics. Corter and Tatsuoka (2004) revealed that Math self-concept and intrinsic motivation are two important forms of motivational resources that have a distinct impact on success.

Parsons et al., (2009) found that success of university Mathematics courses are related to previous accomplishments from Mathematics and confidence in Mathematics. Three types of confidence were identified in their research; overall confidence in Mathematics, confidence for specific Mathematics topics, and application confidence, which is the confidence to apply mathematics skills and knowledge in the future. A study has been carried out on attitudes towards Mathematics, exploring various factors including the effect of individual, motivational and social support factors, revealed significant insights. Mata et al., (2012) identified that variables related to motivation factors are the main predictors of attitudes towards mathematics while teachers and peer supports factors also give significant contribution on attitudes towards mathematics achievement.

Wahid et al., (2014) investigated that math anxiety and attitudes among university students influence their academic performance. Moreover, they claimed that the emotional factors are highly related to math anxiety which causes low mathematics performance. Also, the researchers suggested motivating and keeping self-confidence at high level to avoid math anxiety by improving teaching and learning process. According Brezavšček et al., (2020), mathematics teaching in secondary school is a critical cause for success in mathematics at university level. Furthermore, their findings indicated that variables such as perceived level of math anxiety, self-engagement in mathematic course at university and perceived usefulness of technology in learning mathematics significantly impact the mathematics achievement of university students. Based on the survey data from 419 primary school students, 318 secondary school students and 132 college students in Mainland in Tanzania, Mazana et al., (2018) claimed that the students exhibit a positive attitude towards mathematics at lower grade, but their attitudes become less positive when students move to higher grade of education. Moreover, the study revealed that strategies which are used to teach mathematics, institutional resources and poor learning and examination strategies cause poor achievement in mathematics. Syazana Awaludin et al., (2015) examined the causes of low mathematics achievement in a private university by conducting a survey of 111 private university students and revealed that educational background, student race, age and student esteeming of the importuning of mathematics are cause to law mathematical achievement. It is found that the factors; motivation towards mathematics subject, anxiety towards mathematics, effective support system and collaboration among peers in learning mathematics affect mathematics attitudes of technical university students (Atan and Kasmin, 2018).

An analysis was done based on the survey data of 278 technical university students in Malaysia by Ajisuksmo and Saputri (2017) examined the influence of attitudes towards mathematics and metacognitive awareness on mathematical achievement of students and revealed that there is a significant positive correlation between attitudes towards mathematics and student's mathematics achievements while there is no significant correlation between meta cognitive skills and mathematics skills. Perceived parental influences and teach affective support showed positive relationship towards attitudes of mathematics Davadas and Lay, (2017). Also, further claimed that effective teacher support is more contribute significantly than parental influences on student's attitudes of mathematics. A study has been carried out by Khine et al., (2015) to investigates the factors affect in mathematics achievement among high school students in Gulf State and result showed that the student interest in mathematics, perception of the value of mathematics and students' confidence in mathematics learning has a positive association to mathematics achievement.

Based on the quantitative and qualitative data, Hannula (2002) found that negative emotions are developed since negative attitudes towards mathematics during problem solving studies. Based on the case study, negative attitudes towards mathematics dramatically changed to positive within half a year. A recent study conducted by Hwang and Son (2021) claimed that the students' attitudes towards mathematics depends on the multidimension factors such as interest in mathematics, value of mathematics and confidence in mathematics. Also, they confirmed that there is a positive relationship between students' attitudes towards mathematics and mathematics achievements. Based on the previous studies findings, it is revealed that there is a strong positive relationship between attitude on mathematics and mathematics achievements at university level. It is true students' numerical skills which are needed for anywhere can be enhanced by engaging mathematics course units offered by the university. Most of the students hesitate to add mathematics course units to their degree program since many reasons which still not clear. However, it is very important to produce a student with an artistic background with good numerical skills. Thus, this study mainly aims to reveal the reasons which affect students in artistic background for not selecting mathematics as a subject for their first-degree program.

## METHOD

The undergraduates can enhance their numerical skills to some extent engaging in mathematics course units offers by the universities. However, most of the undergraduates who enrolled to Faculty of Humanities and Social Sciences vacillate to select mathematics course units for their degree programmes. Thus, this study make effort to assess the attitudes of the undergraduates who has artistic background towards making decisions to incorporate mathematics course units for their degree program. All the undergraduates who are studying belong to the faculty of Humanities and Social Science in University of Sri Jayewardenepura which is a leading National University in Sri Lanka was considered as the population for this study. Primary data were collected from the undergraduates from the Faculty of Humanities and Social Science in the University of Sri Jayewardenepura using structured questionnaire and selected a sample size of 352. The stratified random sampling method was employed to ensure a representative sample, encompassing students from all four academic years. Stratification was done based on the academic year of students. Data were gathered by addressing multidimensional variables such as interest in mathematics, peer's opinions, the perceived value of mathematics, math anxiety, self-efficacy, and other relevant factors. Those information across the variables are gathered employed to identify the factors which affect to the decision of the undergraduate towards incorporating mathematics course units for their degree programme.

In order to explore the characteristics of attitudes of undergraduates with respect to making decision to include mathematics course units, two groups of students who followed the mathematics course units and students who did not pursue the mathematics course units were considered. This study derives from the quantitative approach, the dependent variable "Y" is considered as a dichotomous

variable which "1" denotes the undergraduates who incorporated mathematics for their degree programme and "0" for the rest. The reliability and validity of the data were checked using Cronbach alpha values, KMO values, and Bartlett's test. The composition of the sample was presented using tables and graphs while initially Chi square analysis was carried out to find the relationship between considered variable and the choice of Mathematics as a subject for their degree program.

Since the dependent variable is binary, the binary logistics regression model is utilized for the analysis. The dependent variable "Y" takes the value 1 with the probability of "p" and the value 0 with the probability of "1-p". In the binary logistic regression, the relationship between the logit transformation of the outcome and the linear agreement of the predictor variables. The binary logistic regression model can be expressed as follows.

$$ln\left(\frac{p}{1-p}\right)=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+...+\beta_nX_n$$

Here, $\left(\frac{p}{1-p}\right)$ is the odds of success and $\beta_0,\beta_1,\beta_2,\beta_3 \, and \, \beta_n$ are the regression coefficients. The Omnibus test was applied to check the developed model is significantly different from the model with the intercept. Furthermore, Hosmer and Lemeshow test was utilized to test the model adequacy. Figure 1 illustrates the conceptual framework of the study.

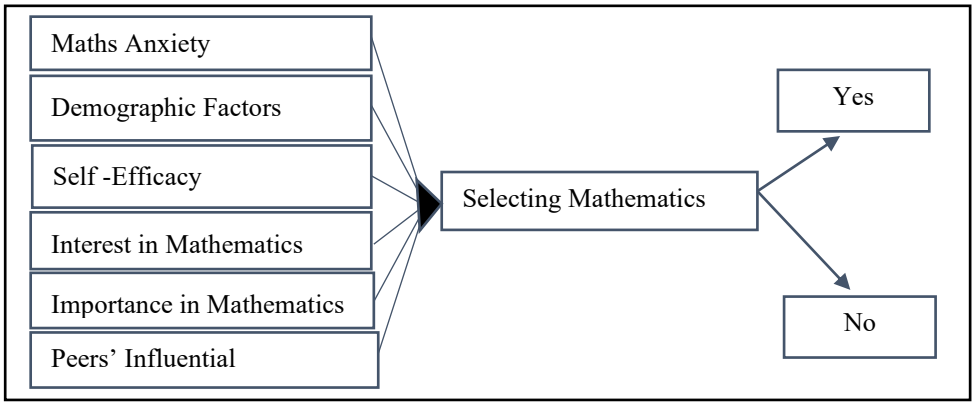


Figure 1
Conceptual framework of the study

## FINDINGS

Descriptive statistics were used to explore the respondents' demographic background. The majority of the respondents are female, and the corresponding percentage is 80%. Thirty-one percent (31%) of the students in the sample belong to Western Province while 24% students are from Southern province and rest of others are from six other provinces except Northern Province. The majority of the students (55.68%) did not select a quantitative subject for their G.C.E. Advanced Level (A/L) while among the 44.32% of students who selected at least one quantitative subject for the A/L, 9.37% selected Basic Mathematics as their first year first semester course unit at the University. Half of the responds (50%) studied at National Schools, while 31.53% and 18.47 % of students studied at Colleges and Central Colleges respectively. Most of the students stated that there are interesting in Mathematics since their childhood accounting for 60.80%. However, 20.74 % of students who were interested in Mathematics did not add the course unit Basic Mathematics to their degree program. Table 1 depicts the student's selection of mathematics course units by Mathematics Result at G.C.E (O/L).

Table 1
Selection of mathematics course unit by mathematics result at G.C.E (O/L)

| Selecting Mathematics Course Unit for the degree | Mathematics Result in Ordinary Level Examination | | | | Total |
|---|---|---|---|---|---|
| | A | B | C | S | |
| Yes | 92 (81.4%) | 47 (52.8%) | 45 (38.1%) | 5 (15.6%) | 189 (53.7%) |
| No | 21 (18.6%) | 42 (47.2%) | 73 (61.9%) | 27 (84.4%) | 163 (46.3%) |
| Count | 113 | 89 | 118 | 32 | 352 |

According to the table 1, 113 (32.1%) students got "A" passes, 89 (25.3%) students got "B" grade while 118 (33.5%) students have obtained "C" passes and the least number of students 32 (9.1%) received "S" passes for the mathematics subject at their O/L examination. The majority of students who obtained "A" grade for the Mathematics in O/L, selected Mathematics course for their degree program accounting 81.4%. A considerable percentage (52.8%) of the students who obtained "B" grade for their O/L mathematics are enrolled to the mathematics course unit offered by the University. Notably 15.6 % of students who obtained simple pass ("S") are also registered for the Mathematics Couse unit at their first year. However, 18.6% of the total students did not register for the mathematics course unit in their first year though they got "A" pass for the mathematics at their G.C.E.(O/L) Examination. Also, nearly 47.2 % of the participants who got "B" pass for the mathematics at their G.C.E.(O/L) examination did not enrol to the mathematic course.

Indices constructed for independent variables using Principal Component Analysis (PCA). The analyses of the validity reliability and total variance of independent were performed. A reliability study was performed on the questionnaire, which measured the internal consistency of the questions as well as item-total correlations. Reliability in the 0.70 range is acceptable, and those above 0.80 are excellent, according to (Sekaran, 2003). The reliability and validity of the data in the independent variables were checked using Cronbach alpha values, KMO values, and Bartlett's test. The corresponding summary statistics are explored by table 2.

Table 2
Summary of the reliability, validity, and total variances of the data set

| Variables | Number of statements | KMO Test | Bartlett test | Cronbach's Alpha test | Total variances |
|---|---|---|---|---|---|
| Mathematical Confidence (CON) | 7 | 0.910 | 0.000 | 0.918 | 67.329 |
| Mathematical Self -Efficacy (SEL_EFF) | 4 | 0.680 | 0.000 | 0.836 | 67.181 |
| Mathematical Anxiety (ANX) | 6 | 0.895 | 0.000 | 0.921 | 72.234 |
| Interest in Mathematics (INT) | 5 | 0.875 | 0.000 | 0.934 | 79.183 |
| Importance in Mathematics (IMP) | 5 | 0.841 | 0.000 | 0.926 | 77.891 |
| Peers Influential (PEER) | 5 | 0.843 | 0.000 | 0.914 | 74.541 |

As per the result of table 2, summary result of the reliability, validity, and the total variances of the data set, all KMO values are greater than (0.6) and Bartlett test values are less than significant level (0.05). The Cronbach's alpha for each variable is greater than 0.70. The high value of alphas suggests that the measurement scales used in the survey are acceptable and reliable. The total variances of all variables greater than 60%. It can also be concluded that this reliability test result also ensures that the statements related to determining the decision to select basic mathematics for the degree program in the first year.

Table 3
Association between variables and selection of Mathematics for their degree program

| Variable | Pearson Chi-Square | P-Value |
|---|---|---|
| Living Area (Province) | 4.472 | 0.724 |
| O/L Mathematics Result | 65.095 | 0.000 |
| Interest in Mathematics | 32.648 | 0.000 |
| Quantitative subjects were selected for A/L in Art Stream | 57.496 | 0.000 |

According to person chi-square test result, it can be concluded that 95% level that there is a significant association between decision of select basic mathematics in first year and some other variables; the respondent' mathematical ordinary level results, interest in mathematics and the whether the quantitative subjects were selected at their G.C.E (A/L). According to the result of the Omnibus test the model all-test statistic values are less than 0.05. excepting to the living area. This shows that there is a significant improvement in fit as compared to the null model. Hence the model is showing good fit. As per the result of the Hosmer and Lemeshow test the model adequately fits the data. Hence, there is no difference between the observed and predicted model.

Table 4
Model summary result of the test

| Step | -2 Log likelihood | Cox & Snell R Square | Nagelkerke R Square |
|---|---|---|---|
| 1 | 430.052[a] | .147 | .196 |

Cox & Snell R Square and Nagelkerke R Square indicate that the percentage of variance of dependent variable explained by the model. Based on those two values it can be concluded that the explained variation in the dependent variable based on the model varies from 14.7% to 19.6%.

Finally, the logistic regression modelling was carried out and the corresponding results of the were shown in Table 5.

Table 5
Variables in the logistic regression equation

| Variable | B | S.E. | Wald | df | Sig. | Exp(B) |
|---|---|---|---|---|---|---|
| Mathematical Confidence (CON) | 0.020 | 0.012 | 2.739 | 1 | 0.098 | 1.020 |
| Mathematical Self -Efficacy (SEL_EFF) | 0.030 | 0.011 | 7.471 | 1 | 0.004 | 1.030 |
| Mathematical Anxiety (ANX) | -0.112 | 0.057 | 3.850 | 1 | 0.040 | 0.894 |
| Interest in Mathematics (INT) | 0.058 | 0.031 | 3.986 | 1 | 0.046 | 1.059 |
| Importance in Mathematics (IMP) | 0.005 | 0.008 | 0.391 | 1 | 0.559 | 1.005 |
| Peers Influential (PEER_INF) | 0.005 | 0.007 | 0.516 | 1 | 0.473 | 1.005 |
| CONSTANT | -0.847 | 0.596 | 2.023 | 1 | 0.155 | 0.429 |

*Note.* df = degree of freedom

According to table 5, Self-efficacy, Mathematical Anxiety, Interest in Mathematics, indices are less than the alpha value, it can be concluded that, those variables have significant effect on selection of Basic Mathematics at their first-year degree program. However, Importance in Mathematics and Peers Influential have not given a considerable effect on this selection.

The fitted model is:

$$\ln\left(\frac{p}{1-p}\right) = -0.847 + 0.030X_1 - 0.112X_2 + 0.058X_3$$

$X_1$= Self Efficacy
$X_2$= Mathematical Anxiety
$X_3$=Interest in Mathematics

The coefficients in the equation indicate the strength and direction of the relationship between each predictor variable and the log-odds of the binary outcome. The intercept (-0.847) represents the log-odds of the binary outcome when all the predictor variables are zero. The coefficient for Self-Efficacy (0.030) indicates that for a one-unit increase in Self-Efficacy, the log-odds of selecting Mathematics course unit for their degree program increased by 3% when holding all other predictor variables constant. It can further explain that the student who has Self-Efficacy has the odds of selecting the mathematics course units 1.03 times higher than the other students. A unit increase of anxiety the odds of a student selecting the mathematics course decreased by 11.2%. Furthermore, it can be concluded that the person does not have much likelihood to add the mathematics course unit for their degree in the first year with the increasing of mathematics anxiety. The coefficient for Interest in Mathematics (0.058) indicates that for a one-unit increase in Interest in Mathematics, the odds of the selecting mathematics course unit of a student is 1.06 times higher than the others. Overall, this logistic regression model can be used to predict the probability of selecting the course unit "Basic Mathematics "for their degree program at their first year based on the values of the predictor variables.

## DISCUSSION, CONCLUSION AND SUGGESTIONS

Every individual requires numerical proficiency to varying degrees in order to make critical decisions through their lives. Particularly, individuals in high-level professions must possess solid numerical knowledge and skills to make informed decisions aimed at advancing both their organizations and their professional careers. As the undergraduate who from artistic background should seek to booster their numerical skills by addressing their weakness. They should take advantage of the resource of universities offer to address their deficiencies in numerical skills. However, many students lack awareness of their future plans and professional goals. They are hesitant to include mathematics courses offered by the university in their degree programmes to enhance their numerical skills. This presents a significant challenge for university admirative bodies too. All responsible persons including academics, members in administrative position in universities need to take necessary action to increase numerical skills of undergraduates by incorporating new attractive teaching methods with modern technology to overcome this problem Saal et al., (2019); Helsa et al., (2023). However, before implementing new methods aimed at improving the numerical skills of undergraduates through encouraging enrolment in mathematics courses, it is vital to investigate the prevailing situation. Also, need to find the real reasons that the majority of undergraduates exhibit reluctance to choose mathematics courses. Thus, his comparison study focuses on the real factors which affect attitudes of undergraduates towards making decisions to select mathematics course unit for their degree programme.

Based on the analysis of this study, mathematical self-efficacy was found to have a significant impact on the decision of selecting mathematics in the first year. It is found that the student who has higher self-efficacy is more likely to do the mathematics course compared to their peers. This study revealed that mathematical interest plays a significant role. Various research outcomes led to the investigators' conclusion that "interest in mathematics" encompasses a broad psychological aspect, encompassing not only a passion for mathematical topics but also an affinity for mathematical terminology, symbols, and routine calculations. According to the finding of this study, interest in mathematics greatly influences the decision to pursue mathematics in the first year. Moreover, this study discovered that a significant negative correlation between mathematics anxiety and the decision to choose mathematics in the first year. This finding suggests that as mathematical anxiety level rise, students are less likely to opt for mathematics courses. Two factors; usefulness of mathematics and peer influence were found to be in significant. Previous literature also has affirmed that the influence of peers on decision is relatively minor. However, prior research has demonstrated that the perceived usefulness of

mathematics significantly impacts on attitudes towards the making decision to select mathematics for their academic programme.

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