Business Education & Accreditation
Vol. 15, No. 1, 2023, pp. 1-15
ISSN: 1944-5903 (print)
ISSN: 2157-0809 (online)

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www.theIBFR.COM

FACTORS INFLUENCING STUDENTS' CHOICE OF MATHEMATICS IN HIGH SCHOOL AND EXPERIENCE IN THE COMPULSORY BUSINESS MATHEMATICS COURSE: EVIDENCE FROM NORWAY

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ABSTRACT

This paper explores business students' attitudes towards mathematics and their choice of mathematics course at high school. We analyze students' preference, skills and attitudes towards mathematics following the Attitudes Towards Mathematic Inventory (ATMI) framework. We examine how their mathematical pathway in secondary school influence how difficult they find an introductory course in business mathematics at the first year of business school. The analysis is based on a survey of 273 students from two business schools in Norway. The results display strong indications that students' choice of mathematics course is linked to the three variables, self-confidence, value, and enjoyment. We also find evidence that the three variables are probably indicators of the choice of mathematical pathway, and not vice versa. This suggestion is based on the study of students who change their minds one year after making their choice and by applying a regression model. Students who choose an easier mathematics course in secondary school, find the business mathematics (BM) at business school substantially more demanding, compared with the group who choose more difficult mathematics in secondary school. We suggest that the main reason for this finding is not the students' choice of mathematical level at high school, but their attitudes towards mathematics.

JEL: A22, M10, M20

KEYWORDS: Attitudes towards Mathematics, Business Mathematics, Mathematics at High School, Business Students, Mathematical Skills

INTRODUCTION

Knowledge and abilities in mathematics is an important indicator of success in business studies. This link is particularly strong in the quantitatively oriented subjects (Alcock, Cockcroft, & Frank, 2008; Ross & Wright, 2022). In some countries, students can choose between different levels of theoretical mathematics at the secondary school (Asian Chaves et al. 2022; Opstad, 2018). Research shows that students who choose more practically oriented mathematics at high school underperform in business courses. Hence, it is important to inform students at high school about the usefulness of mathematics and create a more positive attitude towards the subject, which in turn may result in better achievements in business school (Opstad, 2021). Another approach is to require skills in mathematics upon admission to business schools in the same way as is done for technical education in Norway.

Although previous research shows a clear relationship between the choice of mathematics at high school and performance in mathematics, the causal relationship may nevertheless be unclear. On one hand, the choice may depend on the students' skills and confidence in theoretical mathematics. On the other hand, students with practical mathematics may achieve less success in business courses due to a strained relationship with mathematics and not because of their choice of mathematics courses at high school. The purpose of this article is to explore why business students make different math choices at high school. Furthermore, this article also investigates how the experience with the compulsory course in business mathematics is connected to students' mathematical pathway and their attitudes. Students with a background in practical mathematics, who tend to dislike mathematics, may find this course quite demanding. A deeper understanding of these issues is useful for admission, lecturers and the debate concerning requirements for future students at business schools. To explores these issues, data has been collected by asking 273 business students at 3 different campuses in Norway.

This paper is structured in five sections. After this introduction, a review of the literature is presented in section two. Thereafter, the data and methodology applied in our study is described in section three, before we present our findings in section four. In the fifth section, we summarize the key insights, theoretical implications and the limitations of our study and discuss further research paths.

LITERATURE REVIEW

The Structure of High School Mathematics in Norway

Mathematics is compulsory at high school in Norway. In their first year, the students must choose between practical mathematics (P- math) and theoretical mathematics (T- math). P- math focuses on examples from practical situations in people's everyday life. T- math involves a deeper understanding of topics like geometry, algebra, functions, and probability. It is an introduction of theoretical mathematics. The second year of high school, student have the following options:

Keep learning P-math.
Select mathematics for business and social sciences (S- math).
Mathematics for natural sciences (N- math).

S- math includes analysis of exponential functions, regression models, calculations, and solving equations of first and second degree. Students with N- math deal with algebra, geometry, analysis of figures in planes, and the use of vectors. Students can convert from P math first year to P- or S- math second year, and from T math first year to P-, S-, and N- math second year. The third-year mathematics is voluntary, and the student may continue with S- and N- math.

Previous Research

Students with mathematical skills tend to achieve success in many subjects in courses for Business and Management Administration Degrees (Asian-Chaves, et al., 2022; Opstad, 2018; Tuan et al., 2019).
Many researchers report a positive relationship between attitudes towards mathematics and achievements in mathematics (Ajisuksmo & Saputri, 2017; Bal, 2020; Güner, 2012). Students with positive attitudes towards the subject tend to succeed in mathematics, and this is an important factor explaining good performance in this field.

Students with a background in practical mathematics in high school have much lower self-confidence in mathematics (Opstad & Årethun, 2019a). There is a strong correlation between the choice of level of mathematics at secondary school and attitudes towards mathematics. However, the causal relationship is debatable. Do students choose practical mathematics because they have low self-confidence in the subject, or do they get low self-confidence because they have a background in practical mathematics?

Many students have a negative view towards mathematics. They may obtain a feeling of helplessness and often cannot concentrate when working with mathematics (Hoorfar & Taleb, 2015). These students consider mathematics as quite difficult compared to other subjects (Carey et al., 2019). This might explain the high degree of anxiety towards mathematics. Therefore, many students have a negative emotional reaction to the prospect of learning mathematics. One can dislike, worry, or be frustrated when studying mathematics. Hence, many students might postpone or avoid doing homework in this course. Factors explaining student math anxiety might be (Carey et al., 2019): Negative experience and bad performance in mathematics, negative experiences with how the lecturers teach and present the subject, study habits, general negative attitudes towards mathematics and, finally, some parents do not see the usefulness of learning the subject and this may influence the attitudes of their children.

Brezavšček et al. (2020) report that the teaching style and methods at secondary schools are critical for further success in mathematics. The timing in which anxiety towards mathematics occurs, seem to vary among students (Siebers,2015). Also, the degree of math anxiety varies depending on the difficulty of the mathematical subjects (Ching, 2017).

According to Süren et al. (2020), mathematical anxiety is the key factor when explaining why many students dislike mathematics. A high degree of math anxiety will result in less motivation and lower performance in mathematics (Carey et al., 2016; Hiller et al., 2022; Namkung et al., 2019; Zhang et al., 2019). This may result in a vicious circle: Due to poor performance in mathematics, one gets anxiety towards the subject, which again leads to poorer results. This in turn may cause even greater anxiety towards the subject, etc.

Students' anxiety towards mathematics is closely linked to students' self-efficacy and self-confidence (Irhamna et al., 2020; Schulz, 2005). These variables are strongly correlated (Hiller et al.,2022). High anxiety is an important factor when explaining low levels of self-efficacy and self-confidence in the subject (Steven et al, 2004). Self-confidence is an import factor linked to success in mathematics (Çiftçi & Yildiz, 2019). However, the causal effect could go both directions: Self-confidence leads to success, and vice-versa (Mazana et al., 2019). Opstad (2021) reports that self-confidence is significantly positively related to performance in business mathematics.

Based on previous research and theory, the following research questions will be discussed:

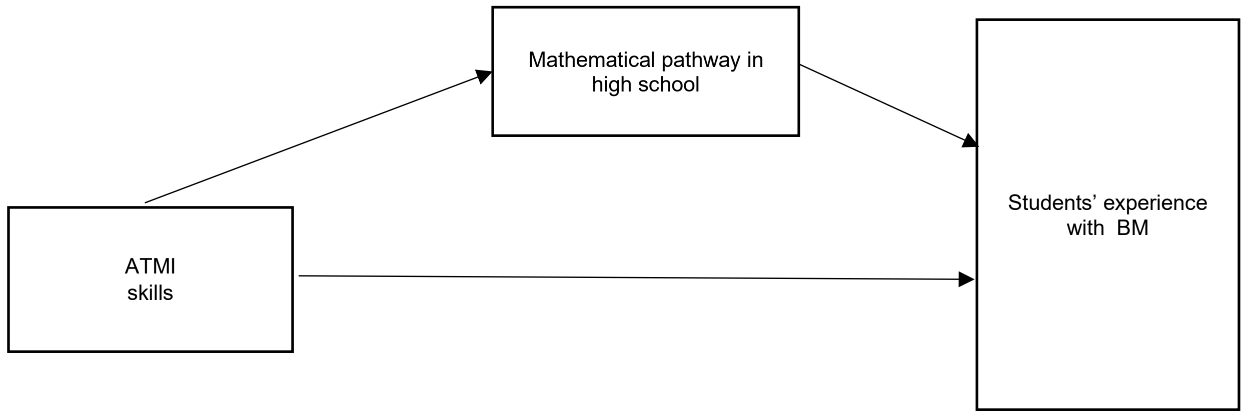
Research question 1: The choice of mathematical pathway at high school depends on students' preferences and attitudes.

An assumption is that students with good theoretical abilities choose T-math in their first year of high school. Students with weaker mathematical abilities tend to choose P- math. In addition, it is assumed that students' academic background, preferences and views on mathematics influence the choice of mathematics direction. In line with previous research, we assume students' attitudes towards mathematics matters (Cerbito, 2020).

Research question 2: Students who have a background in P-math and low score in ATMI (Attitudes Towards Mathematical Inventory) experience business mathematics as more demanding and difficult compared to those who have T- math.

Published articles show that mathematical background and skills are correlated with the success in mathematics and various business courses (Asian Chaves, et al., 2022). Therefore, we assume that students with P-math struggle more to get through the compulsory course in business mathematics. Opstad (2021) suggest ATMI is a key factor in explaining students' performance in Business Mathematics (BM) at the University. ATMI is a survey designed to measure high school and university students' attitudes toward mathematics. In this study, we will investigate which of the two effects from the research questions that is most dominant: Is ATMI or mathematical level at high school is the main factor to explain the students' experience with BM (see figure 1). Which factor has greatest impact?

Figure 1: The Relationship Between Students' Experience with BM (Difficult and Demanding) and ATMI and Students' Choice of Mathematics at High School



The figure explains the assumed relationship between ATMI-score (scores on students' attitudes toward mathematics) and the students self-reported experience with Business Mathematics (BM). This relationship is assumed to be partly direct, shown by the lower vertical arrow, and partly indirect, mediated by their choice of mathematical pathway in high school.

DATA AND METHODOLOGY

The data are collected from a survey that was distributed in a mandatory first year course at two business schools in Norway (NTNU Business School and Western Norway University of Applied Sciences, HVL) in the autumn of 2019. Most students attended the lectures and answered the questionnaire (214 from NTNU and 59 from HVL). Some students choose not to attend the lectures, this is therefore not a random sample. Previous surveys show that this type of survey provides a good picture of the views of the students (Bonesrønning & Opstad, 2015).

There are many papers examining the attitudes towards mathematics (Opstad & Årethun, 2019a). This study is based on the work of Tapia and Marsh (2004), and their Attitudes Towards Mathematic Inventory (ATMI) framework. ATMI includes four factors: (1) Value, (2) Enjoyment, (3) Self-Confidence and (4) Motivation. The method has high reliability and validity (Ngurah & Lynch, 2013). After using factor analyses the last scale was the excluded from our analysis since it did not meet the following 4 requirements (Adelson & McCoach, 2011):

A) The coefficients are higher than 0.4
B) Non-relevant factors are less than 0.3
C) The difference between relevant and non-relevant factors is at least 0.2
D) The value of Cronbach's alfa is above 0.7

As a result, the following categories are used in this study: Value, Self-confidence and Enjoyment (see Table 1). The same data are used by Årethun and Opstad (2023), where the factor analysis is explained in more detail.

Table 1: Attitudes Towards Mathematics

Category	Description
Value	To measure students' beliefs in the usefulness, relevance and worth of mathematics in their life now and in the future
Self-confidence	To measure students' confidence and self-concept of their performance in mathematics. It measures whether students believe that they have enough ability to succeed in mathematics.
Enjoyment	To measure the degree to which students enjoy working with mathematics

This table explains the categories in ATMI (from Opstad & Årethun, 2019b)

The Model

In this study, we will analyze the answers in the questionnaires to answer the two research questions. In this context, statistical methods are primarily used comparing two independent means using T-test. In this way, we can identify whether there are significant differences depending on the students' choice of mathematics path at high school and their ATMI score. In addition, analysis of correlational relationships is also used. The questionnaire is based on a 7-point Likert scale, where 1 is 'completely disagree' and 7 is 'completely agree. A weakness of this approach is that only partial links are considered in the analysis. Therefore, to answer whether it is ATMI or choice of mathematics that explains the students' experience of BM, we have chosen to analyze this simultaneously using following linear regression model:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \varepsilon_i$$

Y: Students' view of BM measured using two variables: (BM is demanding, BM is difficult) (7-point Likert scale)
I = student
β_0 = constant
X_1 = Dummy variable gender (1: M, 0: F)
X_2 = Dummy variable mathematical level high school (1: P-math, 0: others)
X_3 = Self-confidence mathematics (7-point Likert scale)
X_4 = Value mathematics (7-point Likert scale)
X_5 = Enjoyment mathematic (7-point Likert scale)
ε = stochastic error.

The regression analysis considers two dependent variables: BM is demanding and BM is difficult. Gender is included as a standard background variable. There are about as many women as men in this sample. Previous analyses suggest that gender has little impact among business students in Norway (Opstad, 2020).

RESULTS

In this section, we will look at the reasons given by the students for their choice of mathematics, how they experienced the subject at high school, exam results and parental background. In the last part, the relationship between mathematics choices and attitudes towards mathematics generally and business mathematics specifically is analyzed. We study more closely those students who change mathematics course from the first to the second year of high school, as it is interesting to see if they stand out compared to students who do not change direction.

Students' Choice of Mathematics Level at High School (Question 1)

According to Thorsen (2015) 80 percent of the students expect higher grades by choosing P-math. The difference in finding mathematics difficult is significant between T- and P-math (Table 2), This is in line with the suggestion of Opstad and Årethun (2019b).

Students who study T- math are also more likely to have an academic family than students with P- math (measured by the proportion of those who have academic parents). The difference is significant (Table 2).

Table 2: Comparing Scores on Some Variables for T- Math and P- Math-Students, Respectively

Variable	**T-Math (N = 146)**	**P-Math (N = 78)**	**Diff.**	**Two-sided t-test for Differences**
At least one of my parents has a higher education (0: no. 1: yes)	0.89 (0.31)	0.67 (0.47)	0.22 (0.05)	0.001***
I received the following grade for the exam in high school (Fail:0, Highest score:6)[1)]	4.04 (1.06)	3.50 (0.92)	0.54 (0.18)	0.002***
Mathematics first year at high school was difficult and demanding[2)]	4.06 (1.54)	2.14 (1.40)	1.92 (0.20)	0.001***

*The first column in this table shows the mean value scores on some background variables and "find mathematics difficult and demanding" for students choosing theoretical mathematics (T-math) in their first year in high school. The second column shows the corresponding information for students choosing practical mathematic (P-math). The third column shows pairwise observations (T-P). [1]Not everyone had a final exam, therefore N=95 for T, and N=42 for P. [2] The Likert scale ranged from 1 to 7. The selected method is an independent t-test and equal variance assumed and two-tailed significance, standard error in parenthesis. ***: p < 0.01, **: p< 0.05, *:p< 0.1.*

Students were asked to provide the reason for choosing a mathematical pathway at second year at high school (Table 3) It shows a clear pattern. The main purpose for choosing P -math is that the students find the subject easier. However, students with P-math do not find this kind of mathematics relevant for further studies. Even though those with practical mathematics find the subject easier and expect higher success compared to theoretical mathematics, the final mean grade from high school is substantially and significantly lower for the P-group (Table 2).

For students who choose theoretical mathematics (either S- or N- math), the main motives are that it is relevant for further study or that one is interested in mathematics. Hence, there is a substantial difference in interests and motivation among those students choosing theoretical mathematics compared to practical mathematics as reported by Opstad and Årethun (2019b). A higher percentage of P-students find the subject easier and are less motivated compared with N- and S- students (Table 3).

We find a strong significant relationship between attitudes towards mathematics and the selection of level of mathematics at first year at secondary school (Table 4). In particular, the difference is great regarding self-confidence in mathematics. Students who have chosen practical mathematics have a much lower self-confidence than those who prefer theoretical mathematics. The finding is in line with previous research (Shih et al., 2019).

Table 3: Reason for Students' Choice of Mathematical Pathway in High School (P-, S- or N-Math), Measured in Percent

	P-Math (N=96)	S-Math (N= 113)	N-Math (N=59)	ALL[1)] (N=268)
The course is easy	29.1	10.6	8.5	16.8
I am interest in the subject	4.2	28.3	27.1	19.4
I am not motivated for learning mathematics	12.5	2.7	3.4	6.3
It is relevant for further studies	1.0	37.2	47.5	26.5
Other reason	53.1	21.2	13.6	30.9
All	99.9	100.0	100.1	99.9

The table shows students' reason for choosing their specific mathematical pathway in high school. The first column shows the main reason why P-math students (students in practical mathematics) chose this mathematical path in high school, measured in percent of total students attending P-math. The second and third columns provide the same information regarding students who chose S-math (students in mathematics designed for social sciences) and N-math (mathematics designed for natural and technical sciences), respectively. [1] 273 persons responded on the questionnaire, 5 of them did not answer the question regarding their choice of mathematics at high school.

Table 4: Mean Scores on ATMI-Dimensions for Students at Different Mathematical Pathways in Their First Year in High School

Variable	All (N=273)	T-Math (N=146)	P-Math (N=78)	Diff.	Two-sided t-test for Differences
Self-confidence	4.18 (1.18)	4.54 (1.08)	3.58 (1.05)	0.96 (0.15)	0.000 ***
Value	4.86 (1.08)	5.10 (1.00)	4,51 (1.13)	0.59 (0.15)	0.000***
Enjoyment	4.18 (1.08)	4.33 (1.07)	3.96 (0.96)	0.37 (0.15)	0.010 **

*This table shows the mean value scores on the ATMI-dimensions (Self-confidence, Value and Enjoyment) for students who chose either T-math or P-math, respectively, in their first year in high school. The selected method is an independent t-test (T-P), equal variance assumed, and two-tailed significance, standard error in parenthesis. ***: p < 0.01, **: p< 0.05, *:p< 0.1.*

The cause-and-effect correlation is not obvious. Do students choose P-math because they have low confidence or vice versa? To study this, we investigate students who change their minds after their first year and go from T to P-math. (Table 5). We want also to compare those who keep studying P-math against those who change to S-math.

Table 5 shows some interesting results. For students who have low self-confidence in mathematics, the probability that a student substitutes theoretical mathematics in favor of practical mathematics increases. The relationship is strongly significant (Table 5). We find the same correlation for value of mathematics, but the impact is not so strong. The effect is opposite for students who have switched from P to S. They have substantial and significant higher score in attitudes towards mathematics (ATMI) compared to the rest of the P-students. For those who go from P to S mathematics, the result is significantly weaker grades. This confirms the assumption that it is easier to achieve good grades by choosing P-math.

One reason for students to transfer from P- to S-math is that they want to study business administration subjects and realize that S -mathematics is especially useful. We do not have data to confirm this.

Table 5: Students Changing Mathematical Level After First Year in High School Compared to Students Not Changing

	From T to P-Math (N=17)			From P to S Math (N=22)		
Variable	**Changed**	**Diff [1)]**	**Sig.**	**Changed**	**Diff [1)]**	**Sig.**
Self-confidence	3.80 (.92)	-0.83 (0.27)	0.003***	4.11 (0.96)	0.74 (0.25)	0.002***
Value	4.66 (0.92)	-0.50 (0.25)	0.005*	4.83 (0.99)	0.45 (0.28)	0.094*
Enjoyment	4.20 (1.29)	-0.16 (0.33)	0.318	4.19 (0.78)	0.33 (0.24)	0.067*
Grade final exam high school ((Fail:0, Highest score:6)[)]	4.11 (1.17)	0.07 (0.37)	0.419	3.06 (0.93)	-0.71 (0.27)	0.007***

*The first column in of this table (Changed) shows the mean value scores on the ATMI-dimensions (Self-confidence, Value and Enjoyment) for students who changed from T-math to P-math after the first year in high school. The second column (Diff) shows the difference between the ATMI-score for those students who changed from T-math or P-math after the first year in high school and the P-math students who did not change. The fourth and fifth columns have the same interpretation as the first and second column, respectively, with the exception that this is students who changed from P-math to S-math after the first year in high school. In the third column, we compare means by applying a t-test,7-point Likert scale, equal variance assumed and two-tailed significance. Standard error in parenthesis. ***: $p < 0.01$, **: $p< 0.05$, *:$p< 0.1$.*

Our findings suggest that there is a difference between students who choose practical and students who choose theoretical mathematics. Students who have chosen P- math seem to master the subject poorly and many have weak mathematical abilities. It is likely, that the same pattern would have occurred if these students had chosen theoretical mathematics. The selection is largely depending on the students' attitudes to mathematics. P-students want to avoid taking the demanding variant. Even so, they do not achieve good grades. This explains why P- students have lower values in their attitude towards mathematics and especially towards self-confidence.

According to Ching (2017) the level of mathematical anxiety depends on difficulty of the mathematical topics. Based on this reasoning, many of the students who have chosen practical mathematics will probably face major challenges in dealing with theoretical mathematics. This could have led to increased frustration and even more negative attitudes towards the subject. The interpretation is that many people choose P- math because they have weak analytical abilities and will struggle with a more theoretical approach. Based on such reasoning, the result may be that many of these students would have developed more anxiety and depression related to mathematics if they did not have the opportunity to take P- math.

<u>P-Students and Students with Low Score on ATMI Experience Business Mathematics to Be More Difficult and Demanding (Question 2)</u>

Business Mathematics (BM) is a compulsory first year subject for all students attending business schools. It is of interest to study how different mathematics background from secondary school is connected to the experience of BM. We will analyze this in more detail. Furthermore, we also investigate the relationship between ATMI and experience with BM by applying correlation analysis. In the last part we will conduct a simultaneous analysis using the regression model.

Students with P- math experience the introductory course in business mathematics difficult and demanding (Table 6). There are significant differences compared to S- and N-students Therefore, P-students have significant higher study effort (Årethun & Opstad, 2022) and achieve less success in the subject (Opstad, 2021). This confirms the first part of research question 2. Student with P-math tend to find business mathematics quite demanding. Probably, the reason is that these students have weaker mathematical abilities and have a less positive attitude towards the mathematics subject. It is reasonable to assume that the students with the best mathematics skills have a background in N -math. This may explain why there are statistically significant differences between N -and S- math regarding finding BM demanding or difficult.

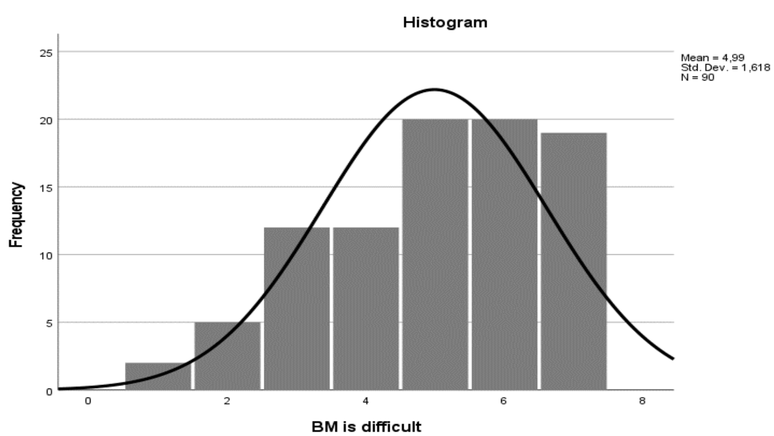
Table 6: Students' View on Some Aspects of the Compulsory Business Mathematics (BM) Course

Variable	All (N= 265)	Diff S-P	Sig	Diff (N-P)	Sig	Diff (N-S)	Sig.
BM is demanding	4.53 (1.72)	-1.44 (0.22)	0.000 ***	-2.51 (0.31)	0.000 ***	-1.07 (0.30)	0.000***
BM is difficult	4.13 (1.74)	-1.44 (0.23)	0.000 ***	-2.36 (0.31)	0.000 ***	-0.92 (0.29)	0.002***
BM is interesting	4.80 (1.34)	0.36 (0.20)	0.007	-0.43 (0.30)	0.140	0.07 (0.27)	0.799
BM is instructive	5.23 (1.27)	-0.004 (0.19)	0.986	0.139 (0.27)	0.606	-0.14 (0.26)	0.575
BM is to no use	2.13 (1.58)	-0.030 (0.23)	0.896	0.372 (0.28)	.181	-0.34 (0.28)	0.232

*The first column of this table shows the mean score regarding the students' view on each of the five aspects of the BM course. The second column shows the difference in the mean score between BM students who attended S-math in high school (S) and BM students who attended P-math in high school (P). The fourth and sixth columns contain the same information as the second column, except that the fourth column is about the difference between those who were N-math students (N) in high school and those who were P-math students (P). The sixth column is about the difference between those who were N-math students (N) in high school and those who were S-math students (S). In the third, fifth and seventh column, we compare independent between S- and P-math, between N-and P-math, and finally between N- and S- math by using t-test, 7-point Likert scale, standard error parentheses, two-tailed significance equal variances assumed. ***: p < 0.01, **: p< 0.05, *:p< 0.1.*

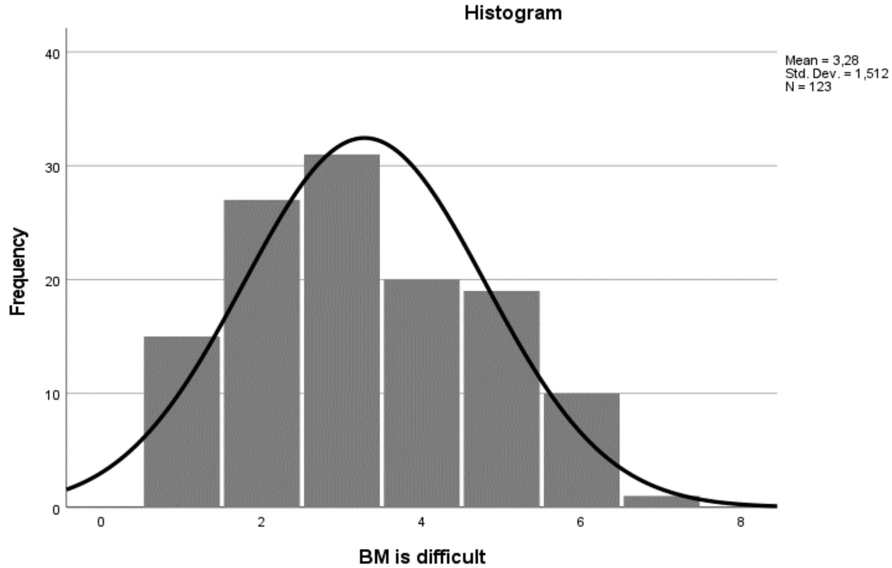
Some students with S- or N- math also experience BM to be difficult (see Figure 3). On the other hand, there are also P- math students who do not experience BM as difficult (Figure 2). Hence, one should be careful to conclude.

Figure 2: The Distribution of P- Math Students Who Find the Introductory Course in Business Mathematics Difficult



This is a histogram showing the distribution of answers to the question on whether students who attended the P-math during high school find business mathematics difficult. The empirical distribution is compared with the normal distribution.

Figure 3: The Distribution of S and N Math Students Who Find the Introductory Course in Business Mathematics Difficult



This is a histogram showing the distribution of answers to the question on whether students who attended either the S-math (mathematics designed for social sciences) or the N-math (mathematics designed for natural and technical sciences) during high school find business mathematics difficult. The empirical distribution is compared with the normal distribution.

We can report a clear relationship between BM and ATMI (Table 7). We find a strong significant negative correlation between ATMI and that BM is demanding and difficult. This confirms the second part of research question 2. The correlation coefficient is particularly high between BM is difficult and Self-confidence.

From the table below, we can see that for students with T math, self-confidence is strongly negatively correlated to how demanding they find BM. On the other hand, for students with P math, the correlation is negligible. One reason for stronger impact on T-math may be that some students choose this mathematical level because it is relevant for further education and careers even though they experience mathematics as difficult (see Figure 2). Table 7 shows nothing about causal relationships. But one possible interpretation could be that students who score low on ATMI (especially self-confidence) struggle with BM regardless of math background in high school. In order to investigate this, we turn to the regression model.

Table 7: Correlation between BM and ATMI

	BM Is Demanding			**BM Is Difficult**		
Variable	**All**	**T-Math**	**P-Math**	**All**	**T-Math**	**P-Math**
Enjoyment	-0.256 ***	-0.307***	-0.037	-0.370***	-0.419***	-0.247**
Value	-0.237***	-0.239***	-0.066	-0.292***	-0.324***	-0.185
Self-Confidence	-0.403***	-0.386***	-0.003	-0.497***	-0.459***	-0.308***

*The first column of this table shows the Pearson's correlation coefficient between students who find BM demanding and each of the three dimensions of ATMI. The second and third column shows the Pearson's correlation coefficient between students who attended T-math or P-math, respectively, on the first year in high school and who find BM demanding and each of the three dimensions of ATMI. The fourth, fifth and sixth column provide the same information as the first, second and third column, respectively, but these columns represent the part of the sample who finds BM difficult. **: p<.05, *** : p< .01.*

The connection to BM is investigated further by a simultaneous analysis (Table 8). In line with previous research gender does not seem to matter as an explanatory factor among Norwegian Business students (Opstad, 2021). Moreover, the results from the regression model confirm our suggestions that it is primarily ATMI that is correlated with the students' perception that BM is demanding and difficult (Table 8). When using a simultaneous model, the significance levels and values of β are much stronger for self-confidence than the dummy variable for math choice in high school. There is a close negative link between students struggle in mathematics and their performance (Mensah et al., 2013). Regarding the dependent variable "BM is difficult", the value of β is much smaller for P-math (and opposite sign) than self -confidence and the impact is only weakly significant. Also for the depended variable "BM is demanding", the influence of P-math is considerably weaker than for self-confidence. The result confirms our assumption that the reason that students struggle with BM is due to the students' difficulty in handling mathematics. This impact is much stronger than the math choice in high school. In other words: It is not the selection of mathematics pathway at high school that causes thestudents' challenges to mathematics, but ATMI. Students who have anxiety in mathematics and low self-esteem largely choose P-math, but not all.

Table 8: Output from the Linear Regression Model

Explanatory Variable	Dependent Variable					
	BM Is Demanding			BM Is Difficult		
	Beta (B)	t-Value	Sig.	Beta (B)	t-Value	Sig.
Gender	-0.020	-0.341	0.733	-0.059	-1.07	0.287
P-math	0.188	3.17	0.002***	0.104	1.82	0.069*
Enjoyment	-0.042	-0.544	0.587	-0.124	-1.68	0.095*
Value	-0.011	-0.147	0.883	0.009	0.13	0.899
Self-confidence	-0.316	- 0.419	-0.000***	-0.406	-5.63	0.000***
	N=263, Adjusted R^2 =.179, R^2 =0.195			N = 261, Adjusted R^2 =.256, R^2 =.256		

The first column of this table shows the linear regression estimates of the standardized Beta-coefficients in the equation: $BM\ is\ demanding = \beta_0 + \beta_1(GENDER) + \beta_2(P\_MATH) + \beta_3(SELF\_CONFIDENCE) + \beta_4(VALUE) + \beta_5(ENJOYMENT)$. *The fourth column contains the same information as the first one, but this regression analysis carries BM is difficult as the dependent variable. VIF values (Variance Inflation Factor) are all between 1.0 and 2.0 (not shown in the table).*

Some Final Comments

Students with N- and S-math outperform students with P- math (Opstad, 2018). For this reason, many would argue that requiring T-math from high school, will ensure much better quality and better results from the students attending business courses. This study shows that this is somewhat hasty and partly a wrong conclusion. An important reason for students to choose P- math is that those students initially have weaker mathematical abilities. Selecting P-math may be the best option since they have problem with theoretical mathematics. If the students struggle with mathematics, they will only to a limited extent handle BM better by switching from P- to T-math. Since theoretical mathematics is more demanding than practical mathematics, the choice of mathematics level affects the ranking of students applying for further studies especially since a student tend to achieve better grades by substituting T- with P-math. This can be compensated by giving additional points for S- and N- math. One can also require that students must take S- or N- math to be admitted to business studies. For quantitative fields such as finance and economics, this may be a way to go. But business courses are complex and heterogeneous. In fields like marketing and management, mathematics may not be such an important tool. Therefore, there is no easy answer. The current system where weak students can choose P- math have clear advantages. This probably leads to more people completing high school and fewer having a strained relationship with mathematics. Hence, one avoids to a greater extent that students get into an undesirable circle with a strained relationship with mathematics (Zhang et al., 2019). Some students have anxiety towards mathematics and therefore they want to avoid a demanding program. On the other hand, research shows that those who have good mathematical skills tend to succeed in business courses (Opstad, 2018). It is likely that business schools will receive more applications when there is no requirement of theoretical mathematics because more students meet the admission requirements.

CONCLUSIONS

In this paper, we have discussed two research questions.

Research question 1: The choice of mathematical pathway in high school depends on students' preferences and attitudes.

Research question 2: Students who have a background in P-math and low score in ATMI experience business mathematics as more demanding and difficult compared to those who have T- math.

We have analyzed business students' choice of mathematics course at the upper secondary school, and students' attitudes using the (ATMI) framework. We generally found great heterogeneity among the students' attitudes, depending on their different mathematical backgrounds. Students choose P-math because it's easy and they lack ambitions regarding further studies, while students who are interested in mathematics and regard this subject as relevant for further studies tend to choose T-math. Particularly, we saw that the variable "self-confidence" appears to be an important predictor of students' choice of mathematics course at the upper secondary school.

The choice of course at secondary school seems to follow students who later attend a business school, as those who initially chose easier mathematics find the course in business mathematics substantially more difficult and demanding than those who chose more difficult mathematics. This effect is, however, reduced when we bring ATMI into a regression model. We found evidence that ATMI is a stronger predictor of attitudes towards business mathematics than the choice of mathematics in high school. It is therefore likely that it is the factors in ATMI, and not the high school choice that contributes to a gap between students in business schools. An understanding of ATMI and the choice of high school mathematics is important to address the gap found in business schools.

Teachers in primary school should try to strengthen the pupils' interest and their self-confidence in mathematics, while professors in universities and colleges may adapt the curriculum to increase the students' sense of value towards mathematics. Although we in this paper present several links and correlations between students' choices and the ATMI framework, the total picture is still unclear. We know that ATMI influences the choice in high school, and that ATMI is important for future performance, and we know some of the mechanisms behind the choices.

Further research is still needed on how to address the gap in mathematics, and how business schools as well as other institutions best may use the knowledge that we have present in this paper. Note however, that we surveyed students in business schools several years after they made their initial choice of mathematics course in upper secondary school. One should therefore apply caution when generalizing our findings to students at other institutions than business schools.

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