DIFFERENT ATTITUDES TOWARDS MATHEMATICS AMONGST TWO GROUPS OF MANAGEMENT STUDENTS: A NORWEGIAN CASE STUDY

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Abstract

The purpose of the present study was to investigate management students' attitudes towards mathematics by comparing two groups. The students in Group 1 had prior professional education (in healthcare, education, and so on) and were taking a master's degree in management. The students in Group 2 were ordinary business and economics students. The sample was taken from different universities in Norway. The chosen methods were pairwise companionship and binary logistic regression. The results showed a substantial difference in attitudes towards mathematics between the two groups, especially in self-confidence. Views on the value of mathematics also differed. The impact of gender was minor in Group 1 and non-existent in Group 2. Attitudes towards mathematics differed between the male and female business and economics students.

Keywords*:* attitudes towards mathematics, gender, higher education in management, quantitative analyses

Introduction

Many researchers have analysed the factors that influence students' attitudes towards mathematics and how these affect their decisions concerning careers and further studies.

. There is, however, a good deal of evidence to show that it is bi-directional. Positive attitudes towards mathematics lead to great effort and better performance, but mastery of the subject generates more positive attitudes. Many researchers work in this field because mathematical skills are associated with high achievement in many subjects, especially quantitative ones, and they impact study and career choices. Attitude and effort in primary and lower secondary school are therefore of great importance. If teachers succeed in motivating students to learn mathematics, it will have positive effects in the future. Many studies have paid particular attention to this issue since many countries have witnessed a decline in the number of secondary upper school students who decide to specialize in mathematics (Berger et al., 2020). This decline corresponds with negative attitudes towards the subject (Han, 2017). Ways of cultivating interest and effort merits should be investigated further (Batool et al., 2020).

The purpose of the present study was to gain more insight into the topic by comparing the attitudes of two groups of students towards mathematics. They were all studying in Norwegian institutions. Group 1 comprised students with backgrounds in sectors such as health and education who were taking a master's programme in management and administration, and Group 2 comprised undergraduates taking business and economics majors. We sought to find whether there was a correlation between attitudes towards mathematics and the choice of direction of education and, if so, whether it was mediated by gender. We also wanted to compare the findings with the results of international studies.

Literature Review

Gender Effect

Researchers have paid close attention to this topic for decades. Many have concluded there is a gender difference (Alcock et al., 2014; Asante, 2012; Kaiser-Messmer, 1993). Girls tend to find mathematics boring; they lack self-confidence, and they fail to see the subject's usefulness. Crombie et al. (2005) suggested that boys believe in using mathematics more than girls. Meelissen and Luyten (2008) found that factors outside the school might account for the gap. Cho (2017) argued that the greater confidence that stems from mathematical ability is more common amongst boys.

There is some evidence that the gender difference in attitudes and success in mathematics has decreased over the past decades (Cvencek et al., 2011). According to Nollenberger et al. (2016), cultural beliefs and women's societal role may explain the inequality in performance and attitudes towards mathematics and why the gender gap

in mathematics various across countries (Smith et al., 2021). Several recent studies found no statistical difference between the sexes in some countries (Batool et al. 2020; Davadas et al., 2020) and even suggested that females have a more positive attitude towards mathematics than males in some regions (Afari & Khine, 2018).

Mathematics and Careers and hypothesis

As has been noted, the gender gap influences career and further study choices. For instance, women are less likely to obtain degrees in science, technology, engineering, and mathematics ([STEM]; Card & Payne, 2020). Mathematical problem solving is a good indicator of whether people will pursue further studies in STEM subjects. Women do not have so much belief in their mathematical abilities and have less mathematical self-efficacy than men, so many choose other fields of study (Saltiel, 2019). Additionally, Sterling et al. (2020) reported a substantial gender gap in salaries amongst STEM graduates.

High anxiety towards mathematics has a negative influence on students' study choices (Morsanyi et al., 2019). Many try to avoid mathematics. Those with low confidence in mathematics look for subjects with minimal mathematical content. There is a strong link between students' belief and confidence in mathematics and their choice of major (Alnahdi, 2020; Larsen et al., 2006). Students who are not comfortable with mathematics tend to select non-quantitative majors (Brown et al., 2008). Opstad (2019) noted a link between economics and business students' attitudes towards mathematics and their choice of study fields. In light of the above, the following hypotheses were proposed:

Hypothesis 1 (H1): There is a gender gap in attitudes towards mathematics amongst management students.
Hypothesis 2 (H2): The choice of study field is determined by the student's attitude towards mathematics.

Sample and Research Methods

The Sample

The data were drawn from questionaries distributed to the participants in 2019. Group 1 comprised master's students from three schools (Norwegian University of Science and Technology, VID University, and Western University of Applied Sciences). Most of them were professionals within the fields of health and education (e.g., nurses and teachers). The students in Group 2 were economics and business majors from the Norwegian University of Science and Technology ([NTNU]; Table 1).

The students were attending compulsory courses. The representativeness of this sample has not been appraised, but other findings indicate it contained students with slightly higher qualifications than the mean (Bonesrønning & Opstad, 2015).

Table 1. *The Study Sample*

Students	Males	Females	Total
Education and healthcare (Group 1)	5	44	49
Business and economics (Group 2)	38	48	86
All	43	92	135

Research Instrument

A widely applied method for measuring students' attitudes towards mathematics is the Attitudes Towards Mathematics Inventory (ATMI; Tapia & Marsch, 2004). It comprises four dimensions: Self-confidence, Value, Motivation, and Enjoyment. Many studies have limited their analysis to three factors by excluding motivation (Lim & Chapman, 2013).

Table 2. *Factor Analysis (A 7-Point Likert Scale with 1* = strongly disagree *and 7* = strongly agree*)*

Factor	Item	Factor loading	Cronbach's alpha
Self-confidence	It is easy to learn mathematics.	0.956	0.922
	I have a great deal of self-confidence in mathematics.	0.908	
	I am able to solve mathematical problems without too much difficulty.	0.823	
Factor	Item	Factor loading	Cronbach's alpha
Value	Mathematics is a very worthwhile and necessary subject.	0.800	0.804
	Mathematics is important in everybody life.	0.784	
	A strong mathematics background can help me in my professional life.	0.652	

A factor analysis of the four dimensions (Adelson & McCoach, 2011) revealed that (a) the coefficient for each item was 0.4 or higher; (b) the coefficient for non-relevant items was not higher than 0.3; (c) the difference between relevant and non-relevant factors was higher than 0.2; and (d) the value of Cronbach's alpha was at least 0.70. Opstad (2019) found few items that captured enjoyment. Therefore, in the present study, we limited the number of factors to two. Only three items were used for self-confidence and value (Table 2).

Table 3. *Descriptive Statistics*

Variable	Mean	Min.	Max.	St. dev.	Skewness	Kurtosis
Gender (0: M; 1: F)	.60	0	1	.49	-.40	-1.86
Value	5.39	1.0	7.0	1.12	-.78	.82
Self-confidence	4.46	1.0	7.0	1.43	-.30	-.46

It can be seen that around 60% of the students were female (Table 1). Furthermore, the mean value of the value factor was higher than that for self-confidence.

Table 4a. *Gender and Group Results(With Standard Error in Parentheses)*

Variable	Gender				Group			
	Females	Males	Diff.	Sig. level	Group 1	Group 2	Diff.	Sig. level
Self-confidence	4.20 (1.48)	4.86 (1.27)	-.67 (.21)	.002	3.57 (1.46)	4.93 (1.16)	-1.53 (.20)	0.000
Value	5.23 (1.15)	5.65 (1.06)	0.43 (0.17)	.012	4.83 (1.15)	5.69 (0.99)	-.86 (.17)	0.000

Table 4b. *Gender Differences Within the Two Groups (With Standard Error in Parentheses)*

Variable	Group 1				Group 2			
	Females (52)	Males (12)	Diff.	Sig. level	Females (57)	Males (61)	Diff.	Sig. level
Self-confidence	3.40 (1.40)	4.29 (1.61)	-0.89 (0.56)	.059	4.92 (1.17)	4.98 (1.18)	-.060 (.22)	.782
Value	4.79 (1.08)	5.03 (1.48)	-0.23 (0.37)	.533	5.62 (1.07)	5.78 (0.92)	-.156 (.18)	.397

Table 4c. *Differences Amongst Females and Males Depending on Chosen Field of Study (With Standard Error in Parentheses)*

Variable	Females				Males			
	Group 1 (52)	Group 2 (57)	Diff.	Sig. level	Group 1 (12)	Group 2 (61)	Diff.	Sig. level
Self-confidence	3.40 (1.40)	4.92 (1.17)	-1.51 (.25)	0.000	4.29 (1.61)	4.98 (1.18)	-686 (.40)	.088
Value	4.79 (1.08)	5.62 (1.07)	.825 (.21)	0.000	5.03 (1.48)	5.78 (.92)	-.748 (.44)	.024

Table 4 a-c show differences depending on gender and groups. By comparing the means and pairwise observations. The chosen method is an independent *t*-test and equal variance assumed and two-tailed significance level).

The pairwise companionship did not take into account the simultaneous impact the different factors had on the result. By using a binary logistic regression model, it was possible to investigate this issue further. The following specification was used:

$$Yi = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \varepsilon_i \qquad (1)$$

where:
Yi: study field (0: Group 1; 1: Group 2),
α_0: constant,
X1: gender (F: 1, M: 0),
X2: mean value of self-confidence using a 7-point Likert score,
X3: mean value for the usefulness of mathematics using a 7-point Likert score,
ε_i: stochastic error.

Table 5. *Results From the Binary Logistic Regression Model*

Variable	B	Wald	Sig. level
Gender	-1.27 (.405)	9.90	.002
Self-confidence	.620 (.159)	15.23	.000
Value	.371 (.186)	3.98	.046
Constant	-3.17 (1.03)	9.39	.002
	Nagelkerke R^{square} = .396, *N* = 186		

Results

Table 4a shows a substantial difference in attitudes towards mathematics between genders and groups. This confirms hypothesis 1 as long as we do not take into account the candidates' choice of study. If we the do that, the gender gaps almost disappear (see Table 4b). Table 4b compares the gender differences within the two groups. For the economics and business students (Group 2) there was no significant gender gap in attitudes towards mathematics. In Group 1, the males had slightly higher scores than the females, and only in self-confidence was the difference significant, though weak (10%). However, table 4c indicates a substantial difference amongst females and males in terms of the selected educational pathway. The females studying economics and business and economics had much higher self-confidence in mathematics and found the subject more valuable than those in Group 1. The pattern was the same for the males, but the impact was considerably weaker though significant at

5% for value and 10% for self-confidence. The regression model (Table 5) shows that the students in Group 2 had a substantial and significantly greater self-confidence in mathematics than those in Group 1. The relationship between study field and value was not so strong, but still significant at 5%. The result confirmed Hypothesis 2, that is, choice of study field was correlated with attitudes towards mathematics.

Discussion

Gender Attitudes Towards Mathematics

The literature is rather mixed on this issue. Traditionally, it suggested that there were gender differences. Males had a more positive attitude towards mathematics and achieved higher scores than females. As a result, there were gender differences in the selection of studies requiring mathematical skills. Many researchers (e.g., Baird & Keene, 2019) have claimed that gender differences regarding mathematics have decreased over the years and that there is now little difference between the sexes. Opstad (2021) found no gender gap amongst a group of business students. Therefore, it is no surprise that the same applies to economics students. Nevertheless, the present study comes to some interesting conclusions. For some of the older students with a background in the health and education sectors (Group 1), there was a slight gender difference in attitudes towards mathematics. The women were more sceptical about it. It is worth noting here that women predominate in the health and social care sector, which suggests t gender differences still exist in terms of education and career choices. When this is taken into consideration, the gender gap regarding attitudes disappears (see Group 2). If, on the other hand, it is not, a significant gender difference remains (see Table 4a).

Chosen Field of Study and Attitudes Towards Mathematics

Some papers have discussed the role of mathematics in business and economics studies (Masui et al., 2014). A bachelor's degree consists of quantitative (economics, accounting, and finance), not qualitative subjects (organisational theory, marketing, and so on). For quantitative courses, there is a strong link between mathematical abilities and success (Brown-Robertson et al., 2015; Opstad, 2018). According to Ballard and Johnsen (2004), quantitative skills were the most important factor for success in introductory economics. Opstad (2018) suggested that mathematical skills were important for performance and useful for different business courses, even non-quantitative ones (e.g., instance business law). Mathematical skills help students to develop better systematic structures and write essays. They also give students a conceptual advantage in law courses.

The students in Group 1 were probably not representative of those with a professional education (such as nurses and teachers). They were selected because they wanted to study management, economics, and law. In these subjects, quantitative abilities are likely to be needed for success. Despite this, there was a big difference in attitudes towards mathematics between Groups 1 and 2. The students in Group 1 had much lower self-confidence than Group 2, so the coefficient in the regression model was high (B = 0.620) and strongly significant (under 0.1%). The students in Group 1 were aware of the importance of mathematics but not to the same degree as the students in Group 2. Therefore, the coefficient was lower (B = 0.371) and the correlation was only slightly significant (under 5%) in the regression model. That the students in Group 2 understood the importance of mathematics may explain why the effect between the two groups was much smaller for value than for self-confidence.

Self-confidence in mathematics and an awareness of the subject's value are predictive of success in management studies, so it would be helpful to find ways of improving students' attitudes. It is therefore important to collect and analyse data on what those attitudes are.

Limitations

The dataset was derived from only three universities in Norway, so this limits the validity of the findings. Furthermore, only two factors regarding attitudes to mathematics were considered. Finally, the links between gender, choice of study, and attitudes towards mathematics were examined, but other variables could be taken into account.

Conclusion

Mathematical skills are important for performance in management and business studies. Since there is a strong correlation between mathematical abilities and attitudes, it is important to identify the nature of those attitudes. In the present study, this was achieved by comparing two groups. The students in Group 1 had a professional education (in health, education, and so on) and were taking a master's degree in management. The students in Group 2 were business and economics undergraduates. There was a significant gender difference in the choice of studies and attitudes towards mathematics. If we take into consideration the students' choice of study field, there was no difference between the genders in Group 2, and the males in the same group were slightly more positive. There was a strong significant correlation between the groups in respect of self-confidence; the impact was much smaller for value. This may indicate that both groups saw the importance of mastering mathematics, even though there were major differences in self-confidence.

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