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Abstract

Each student's effort is an important factor in achievement. Mathematics is an important subject for business students since there is a strong connection between performance in mathematics and success in business courses. The purpose of this paper is to identify the factors influencing a student's choice of how much effort to put into studying business mathematics by questioning 273 students from two business schools in Norway. There is a considerable variation in the study time. By using a linear regression model, we identify the variables linked to effort. Females, and those who have higher enjoyment of mathematics, exert higher effort in business mathematics. Those with a strong background in mathematics from high school and students with parents who have higher education exert less effort in business mathematics. The attitudes toward mathematics do not seem to considerably affect effort.

Introduction

Mathematical abilities are closely related to success in business studies (Opstad, 2018; Opstad et al., 2023; Ross & Wright, 2022). Increasing the number of hours a student works on a particular subject, such as business mathematics, is widely considered as a factor for improving students' academic achievement (Cooper et al., 2006; Corno & Xu, 2004). Lecturers, governmental bodies, the media, international organizations, and policymakers emphasize the anticipated positive correlation between the hours spent working on a subject and achievement. The narrative is that attending lectures, carrying out mandatory assignments, and doing homework affects the grades achieved in a particular subject and the probability of completion. However, the public debate is dominated by general statements based on anecdotes and political ideology and less on academic research (Gill & Schlossman, 2004; Trautwein, 2007; Warton, 2001).While the research regarding the effects of homework on math achievement among students in secondary school has substantially increased over the past 10–15 years (Areepattamannil & Kaur, 2013; Cheema & Sheridan, 2015), there has been significantly less attention paid to students at the university level and the factors affecting their time working on math. Generally, there are rather few studies on the factors influencing undergraduate students' efforts in studying a particular subject. The purpose of the present paper is to analyze the variables affecting effort in an introductory math course at business schools, measured as the number of hours students spend studying.

Effort is a combination of the amount of time and energy spent to meet the formal academic requirements in a specific course. This variable can be split into three different types (Carbonaro, 2005): Rule-oriented effort, which is the time and energy spent on different semi-mandatory activities, such as attending voluntary lectures or completing optional exercises; Procedural effort, which implies the completion of mandatory activities, e.g., required assignments; and intellectual effort, which is exerted when students apply their intellectual and cognitive capacity to absorb and understand the curriculum.

The link between effort and achievement may vary from student to student (Kuehn & Landeras, 2012; Monk, 1992). Smerdon et al., 1999 and Yair, 2000 reported a positive correlation between a student's time spent studying and scholarly outcome, particularly for students who put a lot of rule-oriented or procedural oriented effort into their academic activities. However, this is not a unanimous empirical finding. While many studies have found that effort, measured in the number of hours spent on homework mostly among students in secondary school or high school, do positively affect their grade in math (Areepattamannil & Kaur, 2013; Bratti & Staffolani, 2013;Cheema & Sheridan, 2015; Fernandez-Alonso, Suarez-Alvarez & Muniz, 2015), other studies find no or even a significant negative correlation between students' effort and their achievements in math (De Jong, Westerhof & Creemers, 2000; Kitsantas et al., 2011, Trautwein, 2007).

Several authors (Correa & Gruver,1987; Schmidt,1983) have established a theoretical model to explain students' efforts in various subjects. These authors have employed a utility-maximization approach to analyze student behavior. They highlight the distribution of student time between academic courses and leisure activities. The starting point is that a student has a finite amount of time at their disposal. Therefore, the goal is to optimize this limited time by allocating it among various activities. How much time should be spent studying versus engaging in alternative activities such as leisure or part-time work? How should they divide their time among these various activities? Here, considerations about opportunity cost and substitution must be taken into account. Spending an additional hour on mathematics means less time spent on other subjects or leisure/part-time work. A rational student would distribute their time in such a way that the marginal utility of the last hour spent is equal across all alternative activities. This will be the most effective allocation of activities during a time span, but there are probably differences among students. A student's pace of learning at varying levels of effort is influenced by individual characteristics, such as their innate ability, personal interests, and motivational levels.

Operating on the premise of diminishing returns of scarce resources, this theory elucidates how certain individuals might achieve higher exam performance despite allocating less time to study. This outcome can be attributed to their superior abilities and their heightened efficiency in transforming study time into exam success (Dolton et al., 2003).

Literature Review and Hypotheses

The Structure of High School Mathematics in Norway (extracted from Opstad et al., 2023)

Mathematics is compulsory in 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 to theoretical mathematics. In the second year of high school, the students have the following options:

1. Keep learning P-math (2P).
2. Select mathematics for business and social sciences (S1- math).
3. Mathematics for natural sciences (N1- math).

S- math includes analysis of exponential functions, regression models, calculations, and solving equations of the 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.

Ability, Background, and Effort

If students struggle to understand a subject and study at universities with tough grading, many of them will probably choose to study more (Bonesrønning, 2004). However, if students perform less well than expected, they will probably increase their effort, while students performing better than expected will study less (Bonesrønning & Opstad, 2015). This means that the expected grade and personal ambitions are important factors for understanding students' out of classroom effort. Students with good academic abilities who find the subject easy to understand and who attend high quality lecturing have limited ambitions in terms of good grades, and they do not have to exert considerable effort to achieve their personal aims.

Is there an inverse relationship between students' academic ability and students' effort? Academically poor students must work harder to achieve their goals. This effect depends on the student's personal ambitions (Middleton & Midgley, 2002). However, if there is a demanding subject and it takes a lot of energy to pass the exam, then it is reasonable to assume such a causal relationship. Students might also be unconfident and unsure about their ability and skills to achieve their tasks. If this is the case, students with lower competence tend to study more for achieving their wanted achievements. If a student assumes that they have lower initial ability than their fellow students, this individual will compensate by studying harder (Muenks et al., 2016). However, there are many factors that influence a student's effort. Therefore, according to Muenks and Miele (2017), you should be careful about drawing conclusions about the relationship between abilities and a student's effort. There are substantial individual differences, and the students' effort also depends on the course and program of studies.

Prior knowledge and good skills in a particular subject, or in adjacent subjects, could affect students' effort (Covington, 1998; Opstad & Årethun, 2019b). Students with skills and prior knowledge below average will be less prepared because they lack relevant human capital (Becker, 1975). They struggle to cope with the subject and realize that, without active effort, they risk failing in the course. On the other hand, low skills and abilities in a certain subject could be followed by an evasive strategy based on procrastination, with the number of unsolved math problems and unread chapters mounting up. Their subjective value of attending lectures, handing in assignments, and reading the relevant literature feels quite low, and it may result in less time spent on working on the subject (Jung et al., 2016) This aligns with the findings of Morán-Soto and Benson (2018) who propose that students with low proficiency in mathematics, despite having a strong belief in their own ability to succeed in the subject, may become discouraged and consequently invest minimal effort in understanding mathematics.

According to Brezavšček et al. (2020), achievements in mathematics from high school are a critical factor for success in mathematics in further studies. However, there are different indicators that can measure students' abilities and skills, and the chosen level of mathematics in high school is just one of many indicators. Some talented students may choose practical mathematics in order to receive a high grade, while some weaker students with high ambitions may prefer theoretical mathematics (Opstad, 2024).

Mathematics serves as a supporting subject within business studies and is also applied in other quantitative disciplines. Students with a strong background in mathematics from high school who manage the subject well may, therefore, choose to allocate more of their time to other subjects, such as business economics and accounting. Without exerting too much effort, they can expect to achieve good or acceptable grades in the introductory mathematics course. These factors can result in a negative correlation between mathematical abilities and effort invested in mathematics. In this study, we aim to investigate how the mathematical background from high school is related to the effort exerted on a business mathematics course.

Attitudes and Effort

Some studies have been carried out that try to measure students' attitudes toward mathematics. Fennema and Sherman (1976) applied a set consisting of eight factors measuring different dimensions of the concept of attitudes in general. There have been many modifications since then. Tapia and Marsh (2004) identified four factors measuring attitudes toward mathematics: Self-Confidence, Value, Enjoyment, and Motivation. Motivation received the lowest score. Adelson & McCoach (2011) and Kiwanuka et al. (2017) dropped motivation and developed three factors (Mathematical self-perceptions, enjoyment, and usefulness of Mathematics) by using exploratory factor analysis. The scores on those factors influenced the student's decision to choose the level of mathematics and their achievement.

Several research articles point out that there is a close relationship between attitudes toward mathematics and performance in mathematics (Hwang & Son, 2021; Ma & Kishor,1997; Naungayan, 2022; Panerio, 2016). Students with high confidence in mathematics tend to achieve good grades. In other words, there is a statistically significant link between confidence and good performance in mathematics. The results are not so clear for the dimension of value and enjoyment. Opstad (2024) found no significant correlation between these two factors and success in business mathematics.

Self-confidence in mathematics is a belief that a person is good or bad at that subject (Neale, 1969). A student's expectation of completing a given task depends on their self-confidence in a certain academic area and their self-efficacy regarding the specific task. High scores on self-confidence and self-efficacy make individuals more productive and urge them to perform better (Deci & Ryan, 1985; Elliot & Harackiewicz, 1996 and McClelland,1965). However, there is no obvious connection between self-confidence and effort in mathematics

(McLeod,1992). Based on the theory of optimizing time and benefit, this connection can work in different directions. High confidence, for example, can lead students to be quite sure of achieving the desired results and this can contribute to reduced effort. However, there are also factors that work in the opposite direction. In terms of enjoyment and value, you can imagine that such factors could lead to a higher prioritization of the subject and thereby increased effort. Lambić and Lipkovski (2012) suggest such a connection. In our study, we aim to investigate how attitudes toward mathematics is related to the effort exerted on a business mathematics course. This is an interesting topic and there are not many published articles that have specifically studied this connection. Most of the literature analyzes attitudes toward mathematics linked to achievement.

Academic Parents and Effort

Empirical studies show that students with academic parents achieve better grades (Fan, 2012; Idris et al.2020). Cheng et al. (2020) highlight that there are many factors that explain such a connection. Academic parents tend to engage, motivate, and assist their children with schoolwork. Bonesrønning (2004) demonstrates that this link applies for mathematics for Norwegian students attending secondary schools. Children from low-status families often experience minimal parental involvement and assistance with their schoolwork, thereby contributing to their struggles in school (Anderson, 2002). Dolton et al. (2003) report a negative statistically significant connection between a mother's education and students' efforts. In our study, we aim to investigate how parents' academic background is related to the effort exerted in a business mathematics course.

Gender and Effort

Many studies suggest female students put more effort into homework and other related activities. This gender difference could partly be due to a higher work ethic among females (Mau & Lynn, 2000; Warrington, Younger & Williams, 2000) and that females rely more substantially on their own skills and abilities than males do when carrying out different tasks, which urges them to put more effort into their studies (Harris et al., 1993). In addition, males are more competitive than females and are driven by a desire to succeed in different arenas, such as in academics (Covington, 1998). Therefore, males need to protect their self-worth in case of failure by building a defensive wall of plausible excuses if they fall short in academic achievement due to a lack of intellectual abilities. Those kinds of defensive strategies include procrastination, less real effort, and giving the impression that they can achieve good grades with only marginal effort. In line with the last strategy, male students will deliberately underestimate the weekly number of hours working on math (Jackson, 2003). Even though research shows clear gender differences, the general tendency is that these differences have lessened between the genders. This applies, among other things, to achievements in mathematics (Opstad, 2024). In our study, we aim to investigate how gender is related to the effort exerted in a business mathematics course.

Hypotheses

Based on the above review, we can establish the following five hypotheses:

H1: Students with a background in mathematics for social science and natural science from high school exert less study effort in the introductory business mathematics course compared to students with a background in practical mathematics.

H2: There is a connection between students' attitudes toward mathematics and their study effort.

H3: There is a positive correlation between students with non-academic parents and study efforts in business mathematics.

H4: Females put forth more effort in business mathematics than males.

H5: Students with good grades in mathematics from high school put forth less effort in business mathematics than those with lower grades.

Methodology

The Sample

We have collected data from two Norwegian Bachelor programs in business and administration: NTNU Business School and Western Norway University of Applied Sciences (HVL), Department of Business Administration. A questionnaire was handed out in an arbitrarily selected lecture in the mandatory first semester introductory course in mathematics in fall 2017. There were 273 student responses: 214 were students at NTNU, while 59 studied at HVL. There is little age difference among these students. Much suggests that age influences motivation and effort in mathematics (Saadati & Celis, 2023), but it has not been possible to research this issue in the present study.

The dependent variable in the analyses was covered by the question: "How many hours per week do you work on mathematics, on average, during the present semester, with the time spent on lectures and monitored exercises included?" The intention of this question is to catch the student's mindful effort directed toward learning mathematics. It will, however, exclude math activities conducted in parallel with other activities when performing math or absorbing mathematical knowledge are not the sole objective, such as strolling and wondering about a math problem at the same time or applying mathematics when solving an exercise in a statistics course.

Asking students at an arbitrarily selected lecture could generate a biased sample. Highly skilled students in mathematics could find it irrelevant to attend lectures in this topic. On the other hand, many students with poor skills, including poor mathematical skills, are frequently absent from lectures due to low self-efficacy and low expected gains from attending. Both of these two subpopulations are probably misrepresented in our sample. A similar study comparing characteristics from the population of students (Bonesrønning & Opstad, 2015) found that girls were slightly overrepresented in the sample and the sample GPA was slightly higher than that of the population.

Research Instrument

In order to map students' attitudes toward mathematics, which is needed to answer research question H2, the questionnaire contained a set of statements assessed against a seven-point Likert scale ranging from 1 (fully disagree) to 7 (fully agree). We adopted the approach outlined by Kiwanuka et al. (2017) and Adelson & McCoach (2011) in designing the questionnaire. We limit the categorizing of students' attitudes toward mathematics to three factors: Value, Enjoyment, and Self-confidence in mathematics. Based on factor analyses (see Table 1), the following items were found to load significantly on each of these factors.

Table 1. Factor Analysis to Categorize the Concept of Attitude toward Mathematics (*n* = 273)

	No.	Item (seven point Likert scale)	Factor loading	Cronbach's alpha
Value	1	Mathematics is also an applicable tool in areas other than calculus.	0.461	0.845
	2	Mathematics is important in everyday life.	0.700	
	3	Possessing proper mathematical skills could be important in my professional carrier.	0.454	
	4	Mathematics is a very valuable and necessary subject.	0.772	
	5	Mathematics is one of the most important subjects in school.	0.654	
Self-confidence	1	I have a lot of self-confidence when it comes to mathematics.	0.811	0.909
	2	I am capable of solving math problems without any significant effort.	0.678	
	3	I consider myself as being quite good in solving math problems.	0.798	
	4	It is easy for me to learn mathematics.	0.789	
	5	Mathematics does not scare me at all.	0.748	
Enjoyment	1	I prefer to present my assignments by applying mathematics rather than verbally or by charts.	0.621	0.790
	2	Mathematics is a very interesting subject.	0.454	
	3	I feel very comfortable when solving mathematical problems.	0.436	
	4	I really enjoy embarking on mathematical challenges.	0.734	
	5	I plan to attend more than the required minimum number of courses in mathematics.	0.531	
	6	Mathematics is my favorite subject in business school.	0.627	

The criteria for connecting items to common factors (Adelson and McCoach, 2011):

(a) the coefficient was at least 0.4,

(b) the factor loading for non-relevant factors was less than 0.3,

(c) Cronbach's alpha was above 0.70.

With regards to the other research questions, the questionnaire asked the students to state their gender, choices of mathematics in high school, grade in high school mathematics for their last year that included mathematics, and whether at least one of their parents have completed higher education.

Data

First, we will present some descriptive statistics of our sample. Thereafter, we will compare the means of the binary variables, that is, gender, type of mathematics, and type of parents. Two-sided t-tests will be performed to see if the differences are statistically significant.

To gain a better understanding of how all of the variables are simultaneously linked to business students' effort in their introductory math course, we apply a linear regression model. The following regression model is applied:

$$Y = \beta_0 + \sum_{i=1}^{8} \beta_i + \epsilon$$

Where:

Y: Weekly hours working with mathematics

β_0: Constant

β_1: Dummy variable for female

β_2: Dummy variable S-mathematics

β_3: Dummy variable N-mathematics

β_4: Grade in high school mathematics

β_5: Value

β_6: Enjoyment

β_7: Self-confidence

β_8: Dummy variable for academic parents

ε: Stochastic error

For the gender variable, male is the reference group. For the dummy variables for S and N math, P is the reference variable: Those who choose S and N math in their second year is compared with those who kept learning P-math in their second year. For the academic parents' variable, no academic parents are the reference group. Missing values are merged with the reference group if they account for less than a few percent of the dataset. All of the other variables are scale. To avoid problems with multicollinearity, a correlation test is performed. If two independent variables have a strong correlation, only one of them will be used in the model. Furthermore, only variables with a variance inflation factor below three will be accepted.

Results

Table 2 presents descriptive statistics of the variables in this study

Table 2. Descriptive Statistics for the Variables in the Analyses (*n* = 273)

	Mean	SD	Low	High
Dependent variable:				
Weekly hours working with mathematics	10.90	4.92	2	35
Independent variables:				
Female (F: 1, M: 0)	0.45	-	0	1
P-math (P: 1, Non-P: 0)	0.36	-	0	1
S-math (S: 1, Non-S: 0)	0.40	-	0	1
N-math (N: 1, Non-N: 0)	0.22	-	0	1
Grade in math in final year of high school (Fail: 1, Highest score: 6)	4.30	1.08	2	6
Self-confidence	4.18	1.19	1	7
Value	4.74	1.03	1	7
Enjoyment	4.12	0.93	1	7
Parents higher education	0.82	-	0	1

Students attending the introductory course in Norwegian business schools spend nearly 11 hours per week studying math (Table 2). The number of hours the average student works on mathematics is quite high (attendance and study time). According to Opstad (2021), the time the average student at NTNU spends studying (on all four subjects combined) is around 25 hours. A normal workload is 37.5-40 hours per week, and the business mathematics course is a fourth of the credits of one semester. Therefore, we can see that students on average also spend more time studying business mathematics than what the school schedules.

For the binary variables, Table 3 presents the mean differences in the number of weekly hours working with mathematics.

Table 3. Mean Differences in the Number of Weekly Hours Working with Mathematics

	Mean difference	Standard error
Gender (Females vs. males)	1.95***	0.63
S-math vs. P-math	-3.84***	0.71
N-math vs. P-math	-3.76***	0.73
Parents higher education	-3.44***	1.1

* The mean difference is statistically significant at the 10% level according to the *t*-test.

** The mean difference is statistically significant at the 5% level according to the *t*-test.

*** The mean difference is statistically significant at the 1% level according to the *t*-test.

We can see that female students spend nearly two hours more studying mathematics than males do per week. There is also a significant difference between the S math group and N-math group compared with the P-math group: Students with a background in S-or N-math spend on average close to three hours less time studying mathematics than students with a background in P-math. Finally, we can see that students with at least one parent with higher education spend between three and four hours less time per week with the math course compared with students who do not have parents with higher education.

The results of the regression model are presented in Table 4. We can see that there is a significant gender gap. Female students work significantly more on mathematics than male students, even when other variables affecting working hours have been considered. Students with a background from S and N-mathematics from high school spend substantially fewer hours working on mathematics in the introductory course than students who had learned P-mathematics in high school. Students performing well in math in their final year of high school tend to spend fewer hours working on mathematics during the semester while attending the introductory course in business school compared to students with lower grades in math from high school. The parent variable was also significant in the regression model with a negative coefficient, indicating that those with academic parents spend less time studying math. The attitudes toward mathematics do not seem to matter much. There is only a significant positive link between enjoyment and the effort spent on studying mathematics on the 10% level.

Table 4. Regression Results. The Dependent Variable is Weekly Hours Working with Mathematics while Attending the Introductory Math Course in High School. (Standardized ß)

	Est. ß (std. Error)	Standardized ß	*p*-value	VIF
Constant	15.236 (1.757)***	-	<0.001	
Gender	1.631 (0.626) ***	0.167	0.010	1.19
Self-confidence	-0.270 (0.360)	-0.065	0.454	2.18
Value	0.139 (0.346)	0.031	0.689	1.72
Enjoyment	0.560 (0.334) *	0.136	0.095	1.90
Grade in mathematics in the final year of high school	-0.755 (0.302) **	-0.166	0.013	1.29
S1	-3.468 (0.716) ***	-0.350	<0.001	1.51
N1	-3.827 (0.886) ***	-0.329	<0.001	1.68
Parents higher education	-1.694 (0.788) **	-0.131	0.031	1.05
Adjusted R^2 = 0.192, *N*= 235, VIF= Variance Inflation Factor (within accepted values)				

* The coefficient is statistically significant at the 10% level.

** The coefficient is statistically significant at the 5% level.

*** The coefficient is statistically significant at the 1% level.

Discussion

Multiple studies on gender effects, such as Mau & Lynn (2000) and Warrington, Younger & Williams, (2000), which were conducted on pupils in primary and secondary schools indicate that girls spend more time than boys doing their homework. These findings are in line with our study. According to some studies (Jacob, 2002; Lundberg, 2013), students' non-cognitive skills, like exerting self-control and being persistent, significantly affect the number of hours spent on doing homework, and females have a higher score than males on these attitudes. Female students in secondary school are more self-reliant, disciplined and ambitious than male students (Duckworth & Seligman, 2006; Xu, 2006). Moreover, even when taking several potentially influential factors into account, there are still some unexplainable gender differences left when it comes to the time spent on school subjects during a semester (Schneider, Wallsworth & Gutin, 2014; Gershenson & Holt, 2015).

In the present study, we found that students with better math skills (S- or N-math) from high school spend significantly fewer hours working with math than less-skilled students. On a theoretical basis, two contradictory effects may occur (Becker, 1982). On the one hand, students attending the S- or N-math trajectory in high school have acquired more skills in advanced calculus than students attending P-mathematics. Therefore, P-students find the introductory course in business mathematics more laborious and difficult than other students and they need to work harder on mathematics during business school in order to level out the differences in prior skills (Opstad & Årethun, 2019b). This is in line with classical human-capital theory, stating that previous skills, abilities, and knowledge in a certain academic field will improve an individual's ability to add new skills within similar subjects (Becker, 1975). On the other hand, lower skills in mathematics could deter students from putting a lot of effort into reading the text and solving math problems. This strategy could imply fewer hours spent by former P-students on learning mathematics in business school compared to former S- and N-students. Opstad & Årethun (2019b) find that P-students are less interested in mathematics, and they find the introductory math course in business school less interesting than students with S- or N-math from high school (Opstad & Årethun, 2019a), implying that P-students are less eager to solve math problems and, therefore, they tend to spend fewer hours working with calculus. Our result indicates that students with good mathematical knowledge and background from high school spend less time and effort on learning mathematics in the introductory course.

Those students who enjoy mathematics spend more hours per week on mathematics than the average student. Enjoyment is part of students' attitudes toward mathematics (Hammoudi, 2020; Moenikia & Zahed-Babelan, 2010; Davadas & Lay, 2018), and a large number of studies have shown a positive correlation between students' attitudes toward mathematics as well as students' efforts and results in mathematics (Bilican et al., 2011: Chiesi & Primi, 2009; Lubienski et al., 2012; Opstad, 2021: Moenikia & Zahed-Babelan, 2010; Singh & Imam, 2013). Our study does not find a clear relationship between students' attitudes toward mathematics and the amount of effort spent on the subject.

Better grades in mathematics in the final year of high school will, on average, reduce the number of hours working on mathematics during business school in our study. Good grades in high school may indicate that these students have a talent for learning mathematics and, therefore, they need to spend fewer hours on this subject.Finaly, our study found that students with at least one parent who has completed higher education spend less time studying mathematics in the business course. This result is somewhat surprising, and contradict the conclusions of Dolton et al. (2003), who reported a negative connection between a mother's education and students' efforts. In the literature review, we mentioned several studies showing that students with academic parents achieve better grades. However, this is not in conflict with the finding that these students exert less effort.

Limitations

The data was collected from two business schools. Although it was a large sample, the high admission requirements for the NTNU business school contrasting with the low requirements for HVL could bias the results when generalizing across the population of Norwegian business schools. NTNU students are probably a more homogeneous group with respect to mathematical abilities, skills, and prior knowledge than students at other business schools. The same will probably also be the case for HVL students, where low admission requirements could result in students with moderate prior knowledge of mathematics. The dependent variable, measuring the number of hours the students spend on mathematics during their first semester, could have been expanded to take into account that a student's effort is, at least, two-dimensional. The concept of effort measures time spent on studying mathematical theory or solving math problems, but it measures the intensity as well. How dedicated and focused a student is when completing math assignments will influence the learning process regardless of the time spent on studying.

Conclusion

Business students' skills in and prior knowledge of mathematics have a negative impact on their effort in the introductory math course in business school. These results show that, even though a feeling of enjoyment from studying mathematics and being competent in this area could push business students to increase their effort in learning mathematics, these two factors are outweighed by the negative impact that a high level of skills and knowledge have on the amount of time spent studying. We have also found a gender effect, in which females exert more effort than males, and a parental effect, in which students with parents who have completed higher education exert less effort than students with parents who has not completed higher education. We found a very weak link between the attitudes toward mathematics and study effort. More research needs to be conducted in order to understand why some variables are linked to effort.

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