



## Attitude towards Mathematics of Computer Engineering Students

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### Authors' contributions

The work presented here was carried out in collaboration between all authors. Author AM-M designed the study, wrote the protocol, edited the manuscript and supervised the work. Authors CL-M and JCC collected data and performed the statistical analysis. Author JAR managed the analyses of the study. All authors read and approved the final manuscript.

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### ABSTRACT

There are several factors, which influence people's perception and valuation of different branches of knowledge and particularly of mathematics. This paper reports a study, which investigated the attitudes towards mathematics of computer engineering students. Likert scale test was applied to analyze the attitudes towards mathematics widely used in mathematics education. The results of this research showed that students consider mathematics to be useful, but at the same time complicated and matter of great anxiety. The 50% of participants gave the positive opinion about the usage of mathematics, while only 22% of them had a negative opinion. The usefulness of mathematics was the highest rated factor with an average of 3.38.

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## 1. INTRODUCTION

Mathematics is the main subject in education and training of people and this is reflected in the educational programme of all countries. On the other hand, it is known in the education sector that mathematics generates a lot of difficulties to students at all educational levels. Several studies tried to recognize the mistakes the students make while learning mathematics because these mistakes create difficulties [1,2]. Depending on the educational or professional environment in which you ask about math, positive or negative rating will be obtained. These assessments will be influenced by experience or knowledge of each person and will generate in people diverse beliefs and attitudes towards mathematics.

The assessment tests about mathematics that people take reveal their attitude towards it. The attitude towards mathematics is the willingness of students to act positively or negatively towards mathematics, which determines their intention and influences their behavior [3]. Moreover, McLeod [4] considers appropriate to use the term attitude to refer to math anxiety, confidence, frustration and satisfaction. However, Rokeah [5] believe that attitudes are an organization of predisposed beliefs towards an object or situation.

Furthermore, when people examine the usefulness of mathematics, they refer to its usefulness in their personal life and professional development [6]. Generally, attitudes consist of at least three components: cognitive, affective and behavioral [7-9].

It is important to notice the difference between attitude towards math and math attitude. The former is associated with appreciation, satisfaction, curiosity and interest in mathematics and learning [10,11]. The latter refers to the capabilities of individuals and the ways in which they use those capabilities in a given situation.

Some researches have shown that attitudes towards mathematics are not static but they evolve over time due to various factors [12,13], in other words, attitudes are not necessarily immutable. However Ursini & Sanchez [14] indicates that attitudes towards mathematics of secondary education students are not easily changed, although this may change when the new element is introduced into the teaching process such as a new methodology or the computer itself.

Several studies have shown that students become aware of their motivation or frustration towards mathematics since their early age and the anxiety increases according to the number of years they are learning mathematics [15-17].

At the level of compulsory education students receive basic mathematics knowledge used as a starting point for college they wish to enter one day. In most cases they are not sure why these mathematical skills are useful because they have not yet decided which degree to study at university. But when they enter the university, they evaluate and investigate what is the scope of the chosen degree, what are the subjects they should take and therefore, if there is a significant percentage related to the mathematical world, they should assume a positive attitude towards mathematics.

An important fact to bear in mind is the one Mato & Muñoz [17] described. There have been many researches about attitudes towards mathematics, but there are no studies which describe correlation between them, the factors which generate them and academic performance. We might find out that negative attitudes towards mathematics are not a consequence of its poor efficiency, because the notes of this subject affect the entire academic record and it is necessary to pass math courses to finish one's studies and get the degree.

For that reason, we believe it is necessary and interesting to know what attitudes towards mathematics have students who enter the college to study subjects related to mathematics. We conducted our study under that premise.

## 2. METHODOLOGY

This is an exploratory study that aims to determine the attitudes towards mathematics of computer engineering students, because mathematics is not only an essential part of their university education but will be present in their future professional development. There are no similar studies for students of this degree so far.

Participants are all computer engineering students from the University of Córdoba. The sample consists of 51 first year students of the degree in computer engineering from the University of Córdoba. There are 45 men and 6 women aged 18 to 36 years. 30% of them are over 21 years old. The participation of students in this research was voluntary and anonymous, so

the type of sampling it is intentional and conventional.

The data were taken during the tenth week of the academic year 2013-2014 and we applied the Likert scale to measure attitudes towards mathematics. We opted for the Likert scale because it is the most widely used approach to scaling responses in measurement of attitudes [18]. The scale was designed by Auzmendi [19] who introduced a sample of 1221 Spanish students. It consists of 25 questions with the following score options: Strongly Disagree = 1, Disagree = 2, Neutral (Neither agree nor disagree) = 3, Agree = 4, and Strongly agree = 5.

The questions are grouped into five dimensional factors. To determine the internal consistency of each factor, Cronbach's alpha was determined for each factor:

1. Value or utility (six items)  $\alpha = 0.806$
2. Anxiety (9 items)  $\alpha = 0.911$
3. Liking (4 items)  $\alpha = 0.805$
4. Motivation (3 items)  $\alpha = 0.713$
5. Security-Trust (3 items)  $\alpha = 0.108$

Factor 5 has not been analyzed separately because of its low reliability. The total scale has an  $\alpha = 0.919$ , so it is highly reliable.

### 3. RESULTS AND DISCUSSION

In the first of the research, students rate the usefulness of mathematics with an average of 3.38 (Table 1). Question 1 has the highest

overall score. Although they understand they need mathematics in their studies, the rate for the question 19, which focuses on its importance in their future occupations, is really low. In other words, it is important to get a college degree but not for its use/application in their professional lives. This means that they do not yet understand the potential and necessity of mathematics in the design and development of algorithms for the computer application SPSS version 21.

A third of students (34.96%) are indifferent about the usefulness of mathematics. The 47.38% rated it positively.

In the second part of the research, which was about anxiety (Table 2), the average rating was 3.42. The question 2 was the highest rated, because only 13.7% of the participants agreed with the statement that they were bad at mathematics, similar to the rating of the question 17, referred to anxiety that generates when dealing with mathematics. This research also reveals that they have little confidence when dealing with mathematics and 54.9% said they have fear of this subject. This indicates that most of the students struggle with mathematics.

The third part of the research (which was about liking), the average rating was 2.66 (Table 3). The highest rated question was 14 and only 31.4% of participants reveal that they like mathematics. For half of the students it is unpleasant to talk about math and a third of them (34.31) are indifferent, providing a neutral rating.

**Table 1. Assessment of the value or usefulness of mathematics (Factor 1)**

Question	Mean	Standard deviation	1 (F/%)	2 (F/%)	3 (F/%)	4 (F/%)	5 (F/%)
Q1 I consider mathematics to be necessary in my studies.	4.18	0.79	0	1/2.00	9/17.6	21/41.2	20/39.2
Q6 I want to improve my knowledge and comprehension of mathematics.	3.65	0.79	0	3/5.9	19/37.3	22/43.1	7/13.7
Q15 I hope to have to use little math in my professional life	3.20	1.16	6/11.8	6/11.8	17/33.3	16/31.4	6/11.8
Q16 I think there are more important subjects than mathematics.	2.75	0.868	4/7.8	13/25.5	28/54.9	4/7.8	2/3.9
Q19 I want a job where I have to use mathematics.	2.88	1.07	8/15.7	6/11.8	23/45.1	12/23.5	2/3.9
Q6 Mathematics is one of the most important subjects that I need to study for my professional future	3.67	0.97	1/2.0	6/11.8	11/21.6	24/47.1	9/17.6

The striking fact is that only 15.8% of computer engineering students considered important to study other, not compulsory, math subjects. When their professional career requires strong mathematical tools, and the more knowledge they have, it is easier for them to understand and implement mathematics to provide solutions to the needs of daily life.

Regarding motivation (the fourth part of this research), the average rating is 3.68 (Table 4). The question 5 was the highest rated, because 60.8% of the participants think that mathematics they study is very boring what leads to a lack of understanding of the mentioned subject, and it is extremely important to understand and dominate theoretical foundations of mathematic in order to apply them in an useful and comprehensive way.

This should be essential for students whose degrees are based on mathematics.

Fig. 1 shows that the average rating results about the value or utility of maths and the anxiety it causes in students, are very similar. Motivation received a slightly higher rating than the previous two, while disgust is the lowest rated.

If the overall results of the scale are to be analyzed (Fig. 2), the highest percentage received the ratings that are in favor of established statements (35%) and the lowest those which strongly disagree with them (7%). Half of the students positively rated the aspects related to attitudes towards mathematics, while the 28% of them are in different (neutral rating).

**Table 2. Assessment of anxiety about mathematics (Factor 2)**

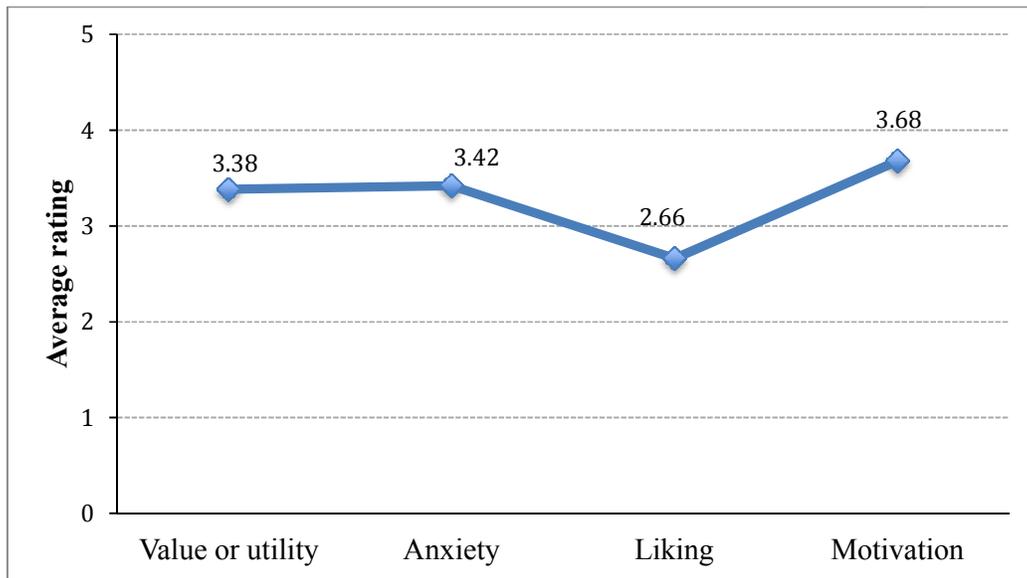
Questions	Mean	Standard deviation	1 (F%)	2 (F%)	3 (F%)	4 (F%)	5 (F%)
Q2 I am really bad at mathematics	3.65	1.07	3/5.9	4/7.8	11/21.6	23/45.1	10/19.6
Q3 Studying or working with math does not scare me at all	3.41	1.09	2/3.9	11/21.6	9/17.6	22/43.1	7/13.7
Q7 Mathematics is one of the subjects that I fear most.	3.35	1.24	5/9.8	9/17.6	9/17.6	19/37.3	9/17.6
Q8 I feel confident while dealing with math problem.	3.35	0.99	2/3.9	7/13.7	19/37.7	17/33.3	6/11.8
Q12 When I deal with a math problem I am unable to think clearly.	3.43	0.92	1/2.0	9/17.6	11/21.6	27/52.9	3/5.9
Q13 I'm calm when I am dealing with a math problem.	3.31	1.09	2/3.9	8/15.7	18/35.3	18/35.3	5/9.8
Q17 Working with math makes me very nervous.	3.61	1.09	3/5.9	5/9.8	11/21.6	22/43.1	10/19.6
Q18 I do not get upset when I have to deal with math problems.	3.08	1.09	4/7.8	12/23.5	15/29.4	16/31.4	4/7.8
Q22 Mathematics makes me feel uncomfortable and nervous.	3.61	1.25	5/9.8	5/9.8	8/15.7	20/39.2	13/25.5

**Table 3. Evaluation of liking for mathematics (Factor 3)**

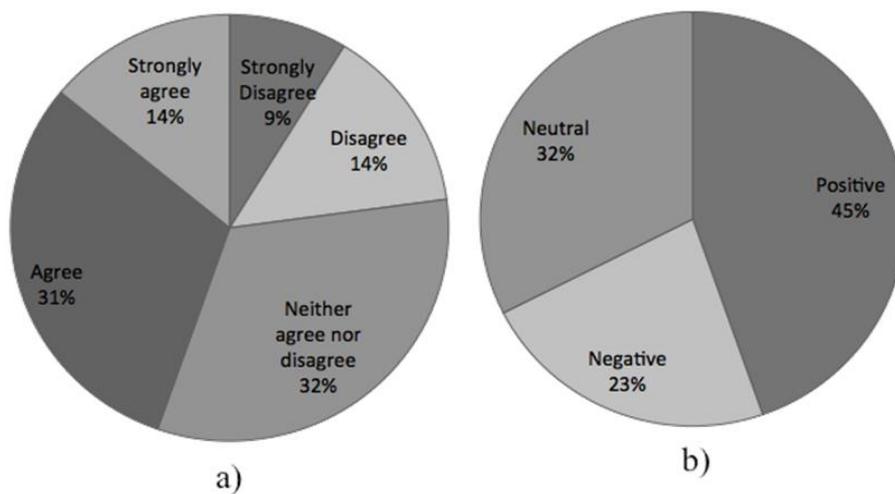
Questions	Mean	Standard deviation	1 (F%)	2 (F%)	3 (F%)	4 (F%)	5 (F%)
Q4 Using mathematics is fun.	2.84	0.98	4/7.8	14/27.5	22/43.1	8/15.7	3/5.9
Q9 I enjoy speaking with others about mathematics.	2.35	1.07	15/29.4	10/19.6	20/39.2	5/9.8	1/2.0
Q14 Mathematics is enjoyable and stimulating.	2.88	1.09	5/9.8	15/29.4	15/29.4	13/25.5	3/5.9
Q24 If I had a chance, I would join more math courses, besides those which are compulsory.	2.59	1.09	9/17.6	13/25.5	21/41.2	6/11.8	2/3.9

**Table 4. Assessment of motivation towards mathematics (Factor 4)**

Questions	Mean	Standard deviation	1 (F/%)	2 (F/%)	3 (F/%)	4 (F/%)	5 (F/%)
Q5 Mathematics is too theoretical to be useful.	4.00	0.82	0	2/3.9	11/21.6	23/45.1	15/29.4
Q10 Mathematics can be useful for students who want to study "science" but not for the rest of them.	3.51	0.98	½.00	7/13.7	16/31.4	19/37.3	8/15.7
Q25 Concepts studied in math classes are not very interesting.	3.53	1.04	3/5.9	5/9.8	12/23.5	24/47.1	7/13.7



**Fig. 1. Average rating results of the four studied dimensions**



**Fig. 2. Total rating scale of ability (a) and the overall score of positive-negative attitudes (b)**

#### 4. CONCLUSION

This paper shows that the computer engineering students viewed positively the usefulness of mathematics and motivation it generates. However, it generates very little pleasure and a lot of anxiety.

Computer professionals are expected to have mathematical skills and knowledge needed to develop applications that provide solutions to situations and problems that were raised during the course of their work. Therefore one of the striking aspects revealed in the study, is when 44% of them gives an affirmative answer to the question if they expect to have to use little math in their careers, what means that they have no clear idea how mathematics is important in their future occupations. Teachers of these subjects should emphasize the importance of mathematics in their professional work/carrier. This means that there should not be only presented the formal part of mathematics, but also its practical application to a real life.

Therefore, over 70% of participants consider mathematics to be too theoretical and do not see its connections with an everyday life. This high response rate may due to the fact that first year engineering students start getting some theoretical and formal mathematical knowledge necessary to be later connected with other non-mathematical subjects to develop personal capacities of a computing professional.

The next task is to compare these results with the assessment of students of other degrees or of the same degree in other universities. It is also necessary to know if they keep their opinion in the last year of their career or these valuations change over time.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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