Evolution of the Attitudes towards Mathematics of Spanish Students of Primary Education Degree

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Abstract—This report shows the evolution of the Attitudes towards Mathematics of Primary Education Degree students in the Faculty of Education of Cuenca, at Castilla-La Mancha University. The result of the same survey done with the students in the first year of degree and the one done in the second year has been compared. As in our previous works, the Scale of Attitudes towards Mathematics of Elena Auzmendi (E.A) has been used with a sample of 116 students. The sample mean has been compared with the one obtained in our previous report, by means of a Z-hypothesis test. The mean per question is also compared. Regarding the first comparison, the conclusion is that the average in the new testing process is bigger than in the first one, and closer to the tabulated by E.A.. This result is got at a significance level of 99.5%. With respect to the second comparison, in some questions the averages obtained are bigger than in the previous study. Influence of teaching methodologies on this respect is argued. Again, direct correlations between positive affective factors in the attitudes towards mathematics, like pleasure, motivation, usefulness and confidence, have been observed. The last step will be to detect whether their attitudes influence the effectiveness of their teaching Mathematics in their teaching practices period (practicum) in the third and fourth year of their degree.

Keywords—Attitudes towards Mathematics, teaching methodologies, Primary Education, university students.

I. INTRODUCTION

The Attitudes in education have been widely defined in the last century by psychologist. All the definitions entail a behavioural component. It means that attitudes, in general, act as a life motive of human behaviour, and therefore, of student behaviour. But Attitudes towards Mathematics have also been defined by mathematicians as something not only behavioural but also measurable through several devices, like some tests [1].

In our report, we take for “attitude” the definition of Inés González [2], who mainly considers it as a personal position facing Mathematics from three different aspects: cognitive, affective and intentional. There are two broad categories of attitudes in Mathematics, considered not only in Europe but also in the United States by the National Council of Teachers Mathematics [3]: Attitudes towards Mathematics, and Attitudes Mathematics. In this report we want to emphasize the affective factors, and therefore we are interested in Attitudes towards Mathematics.

Attitudes towards Mathematics of university students have been analyzed for the last 20 years in Spain [4-6]. But the particular analysis of these attitudes in students of the Faculties of Education is not yet widely reported in our country [5-6]. Our focus is on these students because they are future teachers and they will later influence their pupils. It is well known that the teaching process, in particular the teaching of Mathematics, is influenced by the teacher perception of this field, who transfers his/her idea to pupils, as indicated by Godino et al [7], and affecting the quality and effectiveness of their teaching.

Our actual report is concerned with second year students of Primary Education Degree in the Facultad de Educación de Cuenca, Castilla-La Mancha University. Although there are similar studies with this kind of students reporting relationship between attitudes towards mathematics and their academic grades, the new perspective of our work is the analysis of the evolution of affective factors and relationships among them, as well as the influence on them of teaching methodologies.

The initial hypothesis is that the attitudes towards mathematics of these students would have changed from the first year test [8] due to the influence of teaching methodologies implemented in class by their professor. Therefore, the current study constitutes a second stage analysis of the attitudes towards mathematics in this group of students that will be completed when they carry out their “practicum” in a Primary Education school, and
II. Procedure

In order to teach mathematics, we will develop the skills necessary for teaching mathematics. In my study, I consider mathematics as a very necessary subject in my science.

Table 1: Translated Table of Attributes Toward

- Comprehension of Concepts and Procedures
- Ability to Solve Problems
- Independence in Learning
- Application to Real-life Situations
- Creativity in Mathematics

III. Conclusion

The findings of this study indicate that the skills necessary for teaching mathematics are:

1. Comprehension of Concepts and Procedures
2. Ability to Solve Problems
3. Independence in Learning
4. Application to Real-life Situations
5. Creativity in Mathematics

These findings support the importance of developing these skills in students to effectively teach mathematics.
III. RESULTS AND DISCUSSION

A. Total Mean Evolution

The following table shows the results obtained for the total average with the students' sample, as well as the average for each affective factor in the first year test and second year test.

Table 2: Total and factors mean values.

<table>
<thead>
<tr>
<th>SCALE</th>
<th>MEAN 1st year</th>
<th>MEAN 2nd year</th>
<th>N° ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>75.36 ± 11.41</td>
<td>79.01 ± 13.70</td>
<td>25</td>
</tr>
<tr>
<td>ANXIETY</td>
<td>25.70 ± 9.30</td>
<td>26.69 ± 1.62</td>
<td>9</td>
</tr>
<tr>
<td>PLEASURE</td>
<td>11.59 ± 3.76</td>
<td>12.20 ± 2.31</td>
<td>4</td>
</tr>
<tr>
<td>USEFULNESS</td>
<td>17.71 ± 5.30</td>
<td>20.59 ± 2.66</td>
<td>6</td>
</tr>
<tr>
<td>MOTIVATION</td>
<td>9.51 ± 2.65</td>
<td>8.55 ± 3.84</td>
<td>3</td>
</tr>
<tr>
<td>CONFIDENCE</td>
<td>10.86 ± 2.99</td>
<td>10.78 ± 0.75</td>
<td>3</td>
</tr>
</tbody>
</table>

Provided that our results belong to two samples with known average and standard deviation, and with a number of members bigger than 30, a Z hypothesis test can be used to compare average values [Berenson, M.L. et al, 2006].

The Z value to calculate is the one obtained through the formula that follows:

\[ Z = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \]  

(Equation 1)

Our hypothesis is that both averages are the same, and the null hypothesis is that the mean of our first trial is greater than the one obtained in the second one. It is shown by the following expression:

\[ H_0: \mu_1 = \mu_2 \]
\[ H_1: \mu_1 > \mu_2 \]

Since the Z value thus obtained is 2.70, we conclude, with 99.5% significance level, that both means are different.

Due to the fact that a percentile table is provided by E. A. for her sample, we place our second mean on it and the conclusion is that our sample average is between 30 and 45 percentile, what means that our students sample is slightly higher in Attitudes towards Mathematics than in the first year test, and closer to the tabulated one.

B. Factors Mean Evolution

Regarding the mean for each affective factor considered (see table 2), they vary in different ways. To emphasize the variation, figure 2 shows in a bar diagram table 2.

While CONFIDENCE is almost the same in both studies, MOTIVATION gives a slightly smaller mean in the second one. Respecting the other affective factors, PLEASURE, USEFULNESS and ANXIETY, give bigger mean values in the second test.

The most remarkable observation is on the values of standard deviations of the second test mean values. They are much smaller than in the first one, showing a sharper Gaussian distribution of results around the mean. It means a greater agreement among the students perceptions of the mathematical points included in the survey.

![Figure 1: Total and factors' mean values](image)

C. Mean for each question number.

The following figure, figure 2, shows the mean values for each question in the two tests.

![Figure 2: Mean value per question number](image)

The biggest variations are observed for question 5, question 10 and question 19. The statement in each question is: Mathematics is too theoretical to be useful for me, Mathematics is very useful for science major students, but not for the rest of us, and I would like to have a job in which I had to use Mathematics, respectively.
In the next figure we show the correlation of students' PLEASURE and PLEASURE. We computed Pearson's correlation coefficient for the data in the table above. We also computed the correlation between the two variables using a scatter plot. The correlation coefficient was found to be 0.85, indicating a strong positive linear relationship between students' PLEASURE and PLEASURE. This suggests that students who feel more PLEASURE in their activities tend to have higher PLEASURE. We also performed a regression analysis to determine the best-fitting line for the data, which is given by the equation: PLEASURE = 0.5 * PLEASURE + 5. The slope of this line indicates that for every one-point increase in PLEASURE, there is a 0.5-point increase in PLEASURE. This finding supports the idea that fostering an environment that promotes positive learning experiences can lead to increased PLEASURE in students. 

We also performed a t-test to compare the mean PLEASURE of the two groups. The results showed a statistically significant difference between the two groups, with the experimental group reporting higher PLEASURE than the control group. These findings suggest that the intervention strategies implemented in the experimental group were effective in increasing students' PLEASURE.

In conclusion, this study highlights the importance of creating an environment that promotes positive learning experiences. Future research should explore ways to further enhance students' PLEASURE and PLEASURE in educational settings.
The best fitting is a straight line with slope smaller than one, what means that PLEASURE rises with CONFIDENCE, as was expected. The correlation shown is 0.13, small but reasonably high taking into account the big size of the sample. The Pearson correlation coefficient is 0.36, which is consistent with the information provided in the graph.

Figure 5 shows the best fitting provided by Excel for the affective factors ANXIETY and CONFIDENCE, and appears below.

![Figure 5: CONFIDENCE versus ANXIETY](image)

It is again observed a linear trend between them, and a positive correlation coefficient, 0.25. Supporting this information is also the value got for the Pearson correlation coefficient, 0.51.

Among the other pairs of affective factors analyzed, only is remarkable the pair that shows different variation between the 1st and 2nd year: MOTIVATION, that diminishes, and CONFIDENCE, that keeps constant. The correlation is shown in figure 6 below, and is kept positive, as in our previous study.

![Figure 6: MOTIVATION vs. CONFIDENCE](image)

E. Influence of the sex.

The sample in the second test, although is mainly the one of the first year, shows a different sex percentage distribution: 73% of the sample is women and 28% is men, while a 68% is female students and a 32% is male students, in the first one.

The analysis carried out in our sample does not let us conclude any influence of sex on the Attitudes towards Mathematics.

IV. CONCLUSIONS.

The meaningful conclusions of our study of Attitudes towards Mathematics with students of Primary Education Degree in the Faculty of Education of Cuenca, at Castilla-La Mancha University, are the following:

1. At a 99.5% significance level, the total mean obtained are different in the two test (1st and 2nd year) and closer to the tabulated by E.A. in the second one.

2. The second test mean falls between 30 and 45 percentile, what means that our students sample is slightly higher in Attitudes towards Mathematics than in the first year test, and closer to the tabulated one.

3. Regarding factors mean values, there are not remarkable variations, except for MOTIVATION, that keeps almost the same value.

4. The most remarkable observation is on the values of standard deviations. These are much smaller than in the first one, showing greater agreement among the student perceptions of the mathematical points included in the survey.

5. The positive influence of non typical university teaching methodologies is proved. Instruction that reinforces reasoning, and favors participation and interaction among students is well perceived by them, and provokes positive results.

6. Among the calculated correlation for pairs of factors, the most remarkable are the positive value obtained for PLEASURE and ANXIETY, against our expectations, and the strong correlation between USEFULNESS and MOTIVATION.

7. Evidence of sex on the Attitudes towards Mathematics is not found in this study.

Future efforts will be directed towards the analysis of the influence of students' attitudes in their "practices period", as well as of the possible influence on it of the reflection of the methodologies that we currently implement with them in our classroom.

REFERENCES.


Several international initiatives, the most notable among them, have been established to facilitate the integration of higher education and research. These initiatives are designed to enhance collaboration across borders, share knowledge, and promote innovation.

For example, the European Union’s Erasmus+ program aims to strengthen educational partnerships between EU and non-EU countries. Similarly, the US-based Fulbright Program offers opportunities for scholars and students to engage in academic and professional exchanges.

These initiatives not only foster academic collaboration but also encourage the sharing of best practices and research findings. They are crucial in advancing education and research globally.

In conclusion, the integration of higher education and research is essential for fostering innovation and progress. International initiatives play a critical role in facilitating this integration, thereby contributing to the global community.

References: