

Levels of Teacher Self-Efficacy and Emotions Expressed by Teachers in Training STEM Areas

MARTÍNEZ-BORREGUERO Guadalupe (1), MATEOS-NÚÑEZ Milagros (2),
NARANJO-CORREA Francisco Luis (3)

University of Extremadura, Department of Didactics of Experimental Sciences, Spain (1)

University of Extremadura, Department of Didactics of Experimental Sciences, Spain (2)

University of Extremadura, Department of Didactics of Experimental Sciences, Spain (3)

University of Extremadura, Department of Didactics of Experimental Sciences, Spain (4)

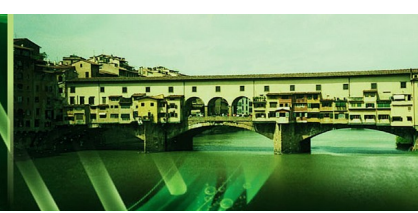
Abstract

The stage of initial training of primary school teachers is particularly relevant to promoting science education for future generations. International reports alert that there is a decline in the choice of STEM (Science, Technology, Engineering and Mathematics) studies, as disinterest and negative emotions towards these subjects increase with age. Within the framework of science education, several studies have been developed analyzing the affective domain in its relationship with the cognitive domain in students of different educational levels. Some studies indicate that primary school teachers in training do not feel competent to teach scientific contents and are unsure about their teaching. This may be related to the emotions they have experienced and continue to experience towards scientific-technological areas. The general objective of this study has been to identify the levels of self-efficacy and the emotions that teachers in training express towards STEM areas. The design of the research has been exploratory and quasi-experimental, with pre-test and post-test to compare the influence of the implementation of external practices on the variables under study. The measuring instruments were designed to analyze their levels of competence for the teaching of STEM curricular contents, the memory of their emotions in their school stage, the importance of certain scientific-educational issues in their training and the emotions they experience during the teaching process of the selected contents. Statistical analysis reveals differences in emotional variables, with positive variables decreasing and negative variables increasing as the academic level increased. At the same time, there are statistically significant differences depending on the block of contents, both in the emotional variables and in the variable level of teaching self-efficacy. Likewise, the comparative analysis of the pre-test versus post-test data shows the existence of statistically significant differences in positive emotions and capacities, depending on the scientific content. Based on this, it is important to highlight the need to strengthen scientific, didactic and emotional competence in primary school teachers in training through methodologies that raise their levels of teacher self-efficacy and emotions towards STEM areas.

Keywords: STEM, Primary Education, Nature Sciences, Technology, Objects and Machines.

1. Introduction

In the last decade there has been a great amount of research related to the importance of the competence domain in the teaching and learning of scientific-technological subjects [1]. The self-efficacy of the teacher is an important motivational construction that determines, in a certain way, the adequate learning of the students. Some authors [2] define teacher self-efficacy as the level of confidence a teacher has in his or her ability to help children learn. Other research [3] has shown that teachers with a high level of self-efficacy are more competent in their teaching practice and do more to help students reach their potential. However, teachers with a low level of self-efficacy are less likely to strive to meet the learning needs of students. These authors [3] also point out that the successful performance of a teacher leads to an increase in self-efficacy, while teacher failure creates a decrease in self-efficacy. Along these lines, it is necessary to consider research that has examined beliefs about the effectiveness of science teaching by teachers in training because it indicates that, once these beliefs are established, they are resistant to change [4]. Other authors [5, 6] revealed that solid prior experience was essential to improve levels of teacher self-efficacy. Specifically, they point out that teacher performance is the most powerful influence in providing authentic evidence of one's performance in a teaching situation. In addition, these authors suggest that positive self-efficacy is related to the acquisition of positive teaching experience and practical training. In other words, exciting and hands-on activities improve their self-efficacy as teachers [7]. In addition, active methodologies



encourage and dynamize interaction in the classroom by facilitating student-teacher feedback. Working on problems linked to reality generates a motivating learning environment that modifies students' attitudes and emotions, preventing possible school failure [8]. Some studies [9] indicate that future teachers show low levels of teacher self-efficacy and little confidence in science teaching, showing negative emotions and attitudes [10]. For this reason, in initial teacher training it would be advisable to analyse levels of teacher self-efficacy in relation to both cognitive and affective domains, especially in STEM (Science, Technology, Engineering and Mathematics) subjects.

2. Methodology

The design of the research has been exploratory and quasi-experimental, with pre-test and post-test to compare the influence of the implementation of external practices on the variables under study. El objetivo general ha sido to identify the levels of self-efficacy and the emotions that teachers in training express towards STEM areas. The participating sample consisted of 71 students from the Primary Education Teacher Degree, teachers in training. It was selected by means of a non-probabilistic sample for convenience due to the ease of access to it.

Two questionnaires were used as a measuring instrument, one as a pre-test and the other as a post-test carried out before and after the teaching practices. In these questionnaires they are asked to evaluate in a first block the scientific areas of their school stage. Subsequently, they have to evaluate different subjects according to the level of importance they have for their training as teachers. In the third block, they must assess from 0 (low level) to 10 (high level) their level of competence and ability to teach subjects and blocks of content related to STEM areas. These contents have been extracted from the primary education curriculum. In the fourth block, they are asked about the emotions they experience as teachers depending on the scientific content and the level of the students to whom they have to teach it.

3. Results

Analysis of the data reveals that the teacher in training has low emotional and competency levels when teaching STEM content in the primary classroom. Figure 1 shows the average frequency rated from 0 (never) to 10 (all the time) of the memory of the emotions they experienced towards the Primary and Secondary Sciences during their school stage.

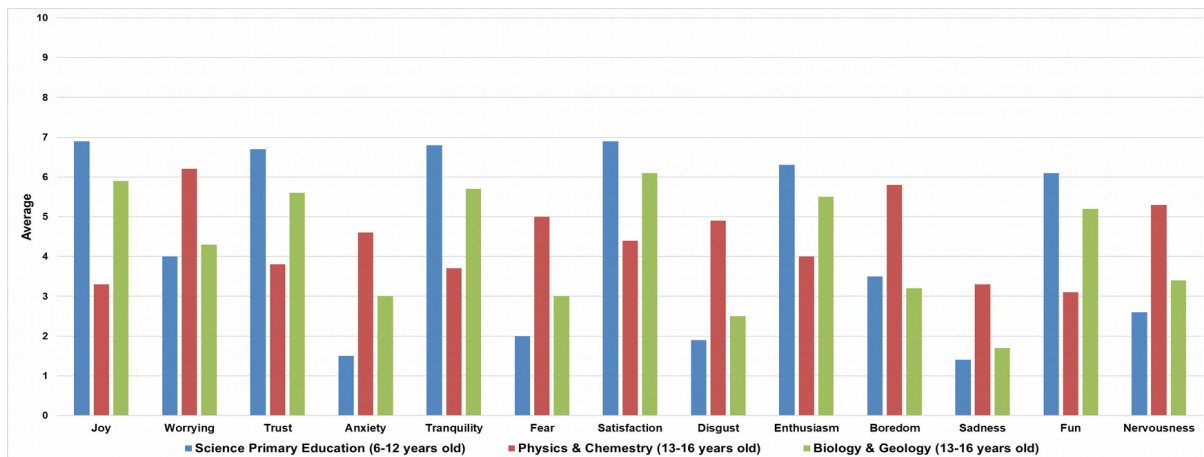


Figure 1. Average frequency of memory of emotions in the pre-test

The pre-test results show that students remember positively the science subjects they studied during their primary education. However, the emotional results change when they reach the secondary stage. Students give high scores to positive emotions when they recall studying and working on biology-related content. In contrast, in physics and chemistry we can observe higher scores in negative emotions, with statistically significant differences (Sig. < 0.05) between these subjects. When comparing these results with those obtained in the post-test, carried out after the practices, it is observed that positive emotions increase, and negative emotions decrease in biology. However, in physics and chemistry, after the practices, negative emotions increase.



Subsequently, an emotional analysis of the blocks of curricular content of Nature Sciences was carried out. Figure 2 shows the results in two of the blocks.

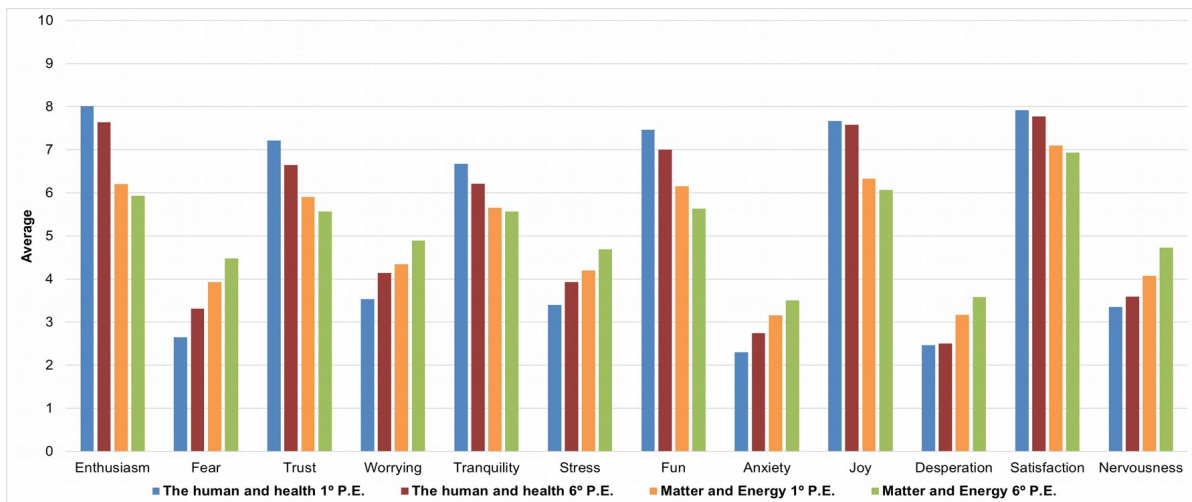


Figure 2. Emotions experienced when teaching certain scientific contents at two educational levels

Figure 2 indicates that, prior to the practices, participants show positive emotions in the "Human Being and Health" block to a greater extent than in the "Matter and Energy" block. As a result, negative emotions occur more frequently in the latter block. After the development of teaching practices, the degree of manifestation of the emotions Fear, Worry, Stress, Anxiety or Despair increases in the blocks related to Physics/Chemistry such as "Matter and Energy", being this difference statistically significant (Sig. > 0.05) with the pre-test data. It is also relevant to note that, in both cases, the scores of negative emotions are somewhat higher in the 6th grade than in the 1st and the positive emotions fall slightly when teaching science in the senior year.

Subsequently, the results referring to the level of teaching self-efficacy in science are shown. Figure 3 shows the results obtained.

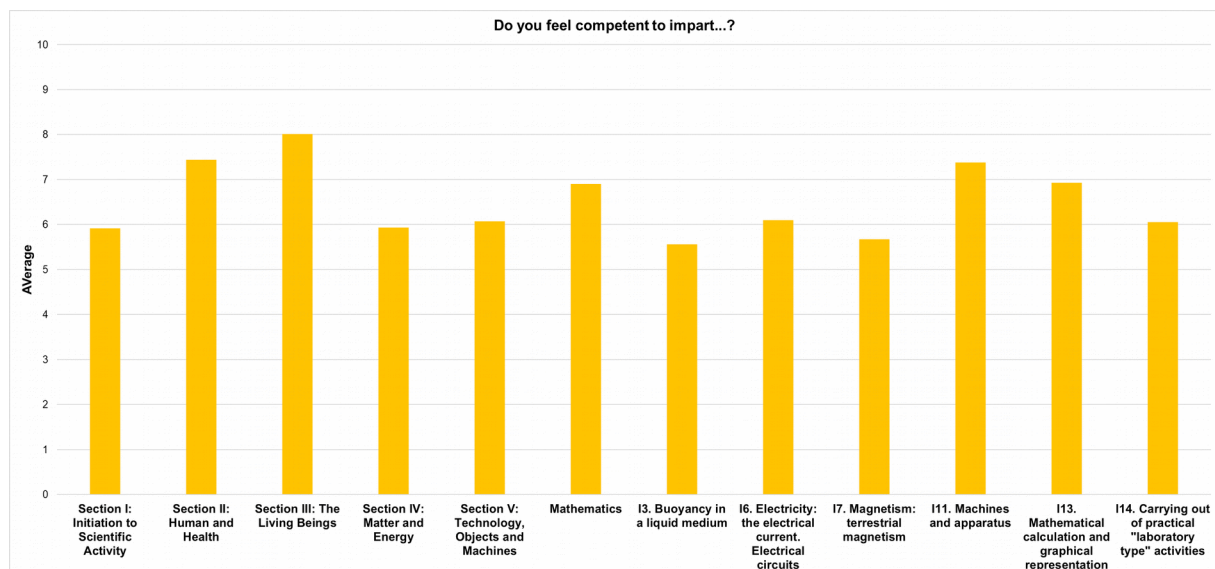
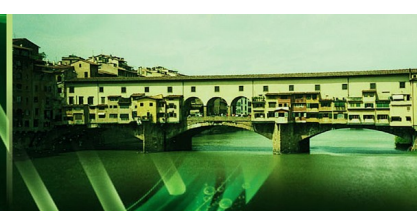


Figure 3. Degree of competency to teach science in primary school

Figure 3 shows that those surveyed show greater competence in teaching blocks that are more linked to biology (BII and BIII) and feel more insecure in those related to Physics/Chemistry (BI, BIV or BV). These results are reconfirmed by analysing the level of teacher self-efficacy in delivering a range of specific content. Figure 3 indicates that the trainee teachers consider that they have a medium-low



level of self-efficacy when teaching primary scientific contents, but above all those more linked to Physics, such as in the case of I3, I6 or I7.

When analyzing the post-test, it was found that the level of teacher self-efficacy improved, although these results were far from being considered favorable.

Subsequently, the respondents assessed the level of importance of some training aspects in the teacher in order to ensure adequate teaching in the classroom (Figure 4). The analysis of these data revealed that future teachers consider these requirements to be important.

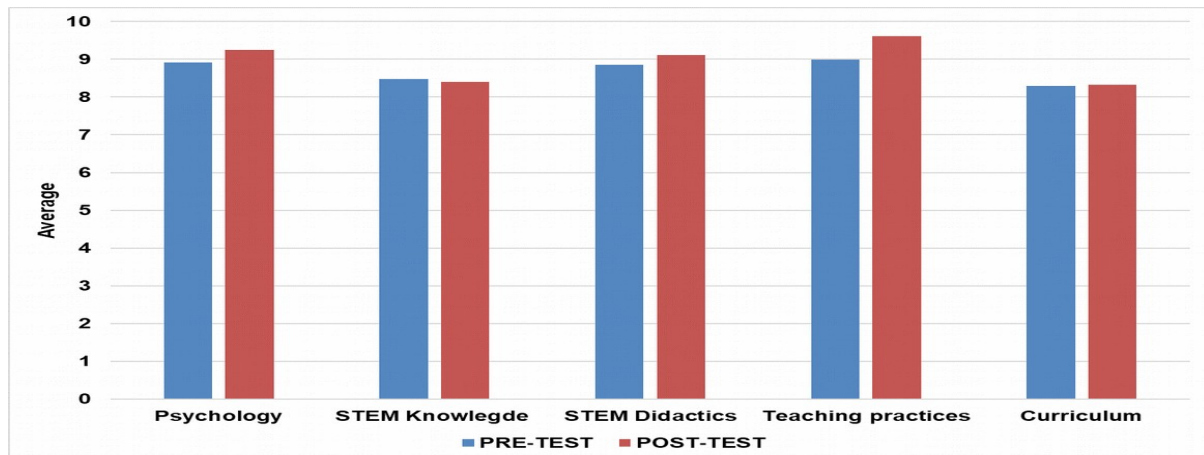


Figure 4. Important aspects in teacher training

4. Conclusion

The previous results show the need to implement methodologies in the classroom that promote the acquisition of the scientific and didactic competence of the teacher in training, in order to improve the teaching of these contents in their future primary students [3]. However, self-efficacy is closely linked to the emotional variable, i.e., students will show higher rates of self-efficacy if they show concentration, control, happiness, participation and satisfaction during school work [11]. Likewise, the teacher's methodology and attitude influence the students' emotions [1]. Therefore, if teachers, when teaching scientific content, feel negative emotions, it is very likely that these negative emotions towards science will be transferred to students. Based on this, it is important to highlight the need to strengthen scientific, didactic and emotional competence in primary school teachers in training through methodologies that raise their levels of teacher self-efficacy and emotions towards STEM areas.

Acknowledgements

Research Projects IB16068 (Junta de Extremadura / Fondo Europeo de Desarrollo Regional), and EDU2016-77007-R (Agencia Estatal de Investigación / Fondo Europeo de Desarrollo Regional). Grant GR18004 (Junta de Extremadura / Fondo Europeo de Desarrollo Regional).

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