



## Training Pre-Service Teachers to Connect Biology Teaching to Daily Life: Role of Positive Emotions

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### Abstract

*Since Primary Education ending, students describe science as an irrelevant discipline to their daily lives. Given this situation it is necessary to promote in classrooms the development of motivating activities of science, highlighting its connection with everyday life. Practical activities have this motivating role but do not provide satisfactory learning outcomes due to their traditional approach. Against this background, it is necessary to train future teachers to develop practical activities under non-traditional approaches as well as to include the interrelationships Science, Technology and Society (STS). This contribution shows the results of the implementation, with a sample of 149 pre-service Primary teachers, of an active intervention of Cell Biology (based on guided research and in which STS relations are highlighted through Biotechnology). The objective is determine if the positive effect of activities linked to daily life is mediated by emotions. For that purpose, we estimate, using a quantitative self-report test, the intensity with which participants experience a set of emotions. This questionnaire measure 8 positive emotions and 8 negative ones, rated on a Likert scale from 1 "not experienced" to 5 "intensely experienced". Cell Biology contents are assessed through questions about Secondary common misconceptions and TIMSS (Trends in International Mathematics and Science Study) questions. Results show positive associations (Spearman correlation,  $p$ -value<0.05) between learning outcomes and the intensities of all examined positive emotions (joy, satisfaction, trust, fun, enthusiasm, gratitude, pride, awe), as well as a negative association between learning results and the intensity of uncertainty. These observations suggest that participants who learn more Biology during the implementation of the active intervention based on STS, are those who feel greater intensities of positive emotions. This interplay between cognitive domain and positive emotions may result key to foster prospective teachers' learning of science as well as significant to improve their future teaching action.*

**Keywords:** Emotions, Science-Technology-Society, active learning, practical teaching, initial teacher training;

### 1. Introduction

Since Primary Education ending, students describe science as an irrelevant discipline to their daily lives, being a field associated to negative emotions such as boredom, frustration and worry [1]. This situation is really worrying, due to academic emotions have important effects on students' learning outcomes. Research has shown that emotions felt by students control and modify cognitive aspects like attention, memory, learning strategies, language or problem solving [2,3,4]. Given this situation, it is necessary to promote the development of motivating activities of science, implementing active practical approaches (based on guided research) and highlighting the connection of science with students' everyday life (including the interrelationships Science, Technology and Society, STS) [5,6]. This is particularly important in future Primary teachers training, since the interplay between their emotions and their learning can determine their future professional performance [1]. To deepen these interactions, in this work we analyse the interplay between the emotions felt by a sample of future Primary teachers with the implementation of an active practical intervention of Biology; and the learning outcomes reached with this activity.



## 2. Methodology

### 2.1 Sample

A sample of 149 participants (67% female, average age 21.5) was obtained from groups of students enrolled in a Natural Sciences Education subject of the Degree in Primary Education (University of Extremadura, Spain). After the implementation of the practice, participants answered two tests: one on the emotions they felt during the implementation of the active practice, and one about core Biology contents. Students were informed about the goals of the research, procedure, duration and anonymity of their data. Participation was voluntarily and it was possible to withdraw participation at any time.

### 2.2 Description of performed intervention

Designed intervention is based on DNA extraction using household materials. It is an active practical activity since:

- It is developed under guided research: students research, guided by teacher, and elaborate its own extraction's protocols
- STS relations are highlighted through Biotechnology applications such as prenatal diagnosis, gene therapy, paternity tests, forensic investigation, food quality control, generation of genetically modified organisms..., including the discussion about their social and ethical aspects

This practice has been deeply described in a previous contribution [7].

### 2.3 Instrument to estimate academic emotions

To determine students' emotions towards the practice, we use a simple and fast quantitative self-report questionnaire measuring 8 positive emotions (joyful, trusting, satisfied, enthusiastic, fun, pride, gratitude, awe) and 8 negative ones (worried, frustrated, uncertainty, nervous, bored, fear, shame, disgust). This test was validated in a previous research through factor analysis [7]. Self-reported tests are the most commonly method used, since they are easy to implement, they hardly affect the development of educational activities and provide measures of subjective and verbalized emotional experiences. Emotions were rated on a Likert scale from 1 "not experienced" to 5 "intensely experienced". Students reported their emotions 15 days after the implementation of the intervention.

### 2.4 Instrument to assess basics of Biology

Biology concepts were assessed through questions about common misconceptions in Secondary school [8,9,10,11] as well as questions extracted from TIMSS (Trends in International Mathematics and Science Study) for Secondary Education [12]. Students answered these questions 15 days after the implementation of the intervention.

### 2.5 Statistical analysis

Due to data do not follow a normal distribution, Spearman correlation analysis are performed (SPSS program). For the extraction of the factors were used generalized least squares and oblimin rotation.

## 3. Results and discussion

Results show positive associations (Spearman correlation,  $p$ -value $<.05$ ) between learning outcomes (measured through Biology test) and the intensities of all examined positive emotions (joy, satisfaction, trust, fun, enthusiasm, gratitude, pride, awe); as well as a negative association between learning results and the intensity of uncertainty (Table 1). These observations agree with several previous researches that revealed that emotional information is better remembered than neutral information [2,3,4], especially for positive emotions [13]. These observations suggest that participants who learn more Biology contents with the implementation of the active intervention based on STS, are those who feel greater intensities of positive emotions. This interaction can be observed in Figure 1, which represents the linear regression between test's mark and a factor calculated for all positive emotions. This interplay between cognitive domain and positive emotions may result key to foster prospective teachers' learning of science, as well as significant to improve their future teaching action.

However, this interplay does not allow us to establish a cause-effect interaction; although suggest that positive emotions encourage learning and/or learning improve positive emotions. Then, future researches are required to deep in this interplay and determine a possible causality. Even so, results show that positive emotions felt by a sample of future teachers, during an active activity based on



STS, are related to learning outcomes; suggesting that Biology learning may be fostered by raising active practical activities that connect Biology concepts to students' daily lives (using STS relations).

Table 1: Coefficients of correlation between the intensity of emotions experienced during the implementation of designed intervention and Biology learning outcomes (mark of Biology test). Bolds highlights significant correlations (Spearman correlations, \*\*\*p-value<.001, \*\*p-value<.01, \*p-value<.05)

Positive emotions	Correlation with Biology test	Negative emotions	Correlation with Biology test
Joyful	<b>.198*</b>	Nervousness	-.084
Trust	<b>.277***</b>	Boredom	-.134
Satisfaction	<b>.235**</b>	Frustration	-.103
Enthusiasm	<b>.241**</b>	Worry	-.060
Fun	<b>.238**</b>	Uncertainty	<b>-.163*</b>
Pride	<b>.239**</b>	Fear	-.076
Gratitude	<b>.229**</b>	Shame	.087
Awe	<b>.169*</b>	Disgust	-.069

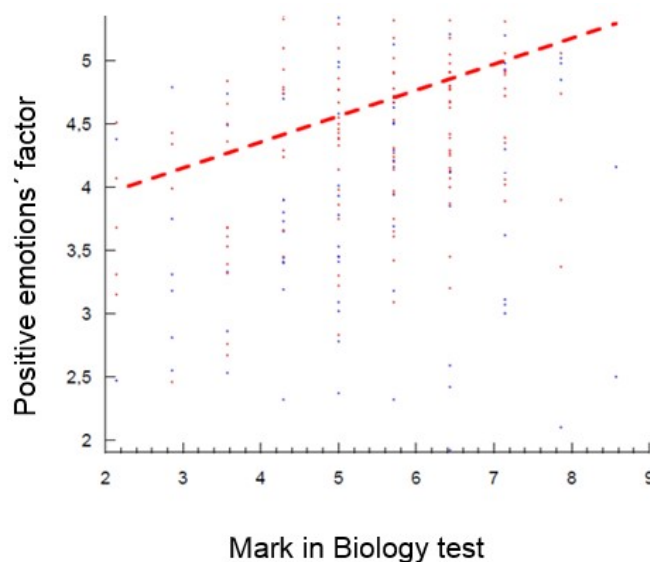


Figure 1. Linear regression between positive emotions' factor and Biology learning outcomes (Biology test's mark).

#### 4. Conclusion

Results reveal that positive emotions (namely: joy, satisfaction, trust, fun, enthusiasm, gratitude, pride, awe) felt by a sample of future Primary teachers, during the implementation of an innovative active activity based on STS; are related to students' learning outcomes. Due to emotions felt by Primary teachers influence teaching-learning processes, these interactions should be taken into account in initial teachers training.

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