



## Interactions between Learning and Emotions in Prospective Primary Teachers towards an Active Practice of Biology

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### Abstract

*Students experience a great diversity of emotions in academic settings: there is virtually no major human emotion not experienced in a classroom. These emotions are expected to have important effects on students' learning outcomes since control their attention, influence their motivation to learn and modify their learning strategies. Due to affective domain and cognition are integrated in the brain in critical areas for regulating the flow of information between regions, academic emotions and science learning are reciprocally conditioned. Therefore it is important to simultaneously look into affective and cognitive aspects in teaching-learning processes. This is particularly important in future Primary teachers, since the interplay between emotions and learning can determine their future professional performance. To deepen these interactions, in this contribution we analyse the relationships between the emotions experienced by a sample of 159 students of the Degree in Primary Education (University of Extremadura), before and after the implementation of an active practical intervention of Biology (based on guided research); and their level of Biology knowledge, both previous and acquired with the performed intervention. Emotions are assessed using a simple and quantitative self-report test which was validated in a previous research through factor analysis. This questionnaire measure ten academic emotions (5 positive emotions and 5 negative emotions), rated on a Likert scale from 1 "not experienced" to 5 "intensely experienced". Meanwhile Biology fundamental concepts are assessed through multiple-choice questions about common misconceptions in Secondary school as well questions extracted from TIMSS (Trends in International Mathematics and Science Study), which is designed to estimate science achievement in Secondary Education. Results reveal positive associations between the intensity of joy, enthusiasm, satisfaction and fun experienced during the practice and learning outcomes, as well as negative associations between them and the intensities of frustration and worry. Likewise, results indicate that low levels of previous Biology knowledge of Secondary Education are predictors of high intensities of boredom, frustration and worry, as well as that the previous intensity of enthusiasm can have predictive value in relation to learning.*

**Keywords:** Emotions, learning, initial teacher training, Primary Education, guided research;

### 1. Introduction

Classroom is an emotional place: all human emotions are experienced in different academic settings. Despite this diversity, academic emotions have been neglected by research in science education for decades [1]. Cognition and emotions are integrated in the brain in critical areas for regulating the flow of information between regions [2], being reciprocally conditioned [3]. Due to this interaction, academic emotions have important effects on students' learning outcomes since control their attention, influence their memory and modify their motivation to learn and their learning strategies [4, 5, 6]. Taking into account this influence, it is important to simultaneously look into affective and cognitive aspects in teaching-learning processes; particularly in future Primary teachers training, since the interplay between their emotions and their learning can determine their future professional performance [7]. To deepen these relations, in this research we analyse the interactions between the emotions experienced by a sample of future Primary teachers, before and after the implementation of an active practical intervention of Biology; and their level of Biology knowledge, both previous and acquired with the performed intervention.



## 2. Methodology

### 2.1 Sample

A sample of 159 volunteers (66% female, average age 22) was obtained from three groups of students enrolled in the Bachelor in Primary Education at University of Extremadura in its two campuses in Cáceres and Badajoz (Extremadura, Spain). Students were informed about the goals of the research, duration, procedure and anonymity of their data. Participants answered two questionnaires before and after an active practical activity related to Cell Biology Education (developed under guided research): one on the emotions they felt towards the practice and one about core Cell Biology concepts. This practice has been described in a previous work [8].

### 2.2 Instruments

To determine academic emotions, we use a simple and fast quantitative self-report test measuring ten academic emotions (joyful, trusting, satisfied, enthusiastic, fun, worried, frustrated, uncertainty, nervous, bored), validated in a previous work through factor analysis [8]. Self-reported emotions measurement is among the most commonly method used, since it is easy to implement, it hardly affects the development of classroom's activities and provides measures of subjective and verbalized emotional experiences. In addition, academic emotions were assessed using single items since, compared to longer multi-item state measures, provide enough validity, require less time and are less intrusive with emotional responses of participants [1]. Emotions were rated on a Likert scale from 1 "not experienced" to 5 "intensely experienced". Students reported their emotions before the intervention (how they thought they were going to feel with the implementation of the activity) and 2 weeks after its implementation (how they really felt during the activity). Cell Biology core concepts were assessed through multiple-choice questions about common misconceptions in Secondary school [9,10,11,12] as well as questions extracted from TIMSS (Trends in International Mathematics and Science Study), which is designed to estimate science achievement in Secondary Education (age 12-16 in Spain) [13]. Students answered these questions before the intervention (pretest, with which to determine previous Cell Biology knowledge) and 2 weeks after its implementation (posttest, with which to determine learning outcomes achieved with the implemented activity).

### 2.3 Statistical analysis

Due to data do not follow a normal distribution, Spearman correlation analysis are performed (SPSS program).

## 3. Results and discussion

Results reveal positive associations between the intensity of joy, enthusiasm, satisfaction and fun experienced during the implementation of the practice and learning outcomes, as well as negative associations between them and the intensities of frustration and worry (Table 1). These observations agree with several previous researches that revealed that emotional information is better remembered [4, 5, 6].

Table 1. Coefficients of correlation between the intensity of emotions experienced with an active practice of Cell Biology and the Cell Biology learning outcomes achieved after its implementation (postest's mark). Bolds highlights significant correlations (Spearman, \*\*\*p-value<.001, \*\*p-value<.01, \*p-value<.05)

Emotions felt with an active practice of Cell Biology	Correlation with Microbiology postest
Joyful	<b>.276***</b>
Trust	.130
Satisfaction	<b>.278***</b>
Enthusiasm	<b>.279***</b>
Fun	<b>.213**</b>
Nervousness	-.056
Boredom	-.149
Frustration	<b>-.200*</b>
Worry	<b>-.196*</b>
Uncertainty	-.068



Regarding the predictive value in emotions-learning interactions, results indicate that low levels of previous Biology knowledge of Secondary Education are predictors of high intensities of boredom, frustration and worry (Table 2), as well as that the previous intensity of enthusiasm can have predictive value in relation to learning (Table 3). The predictive value of previous knowledge regarding present negative emotions has been described by several previous studies [1, 14]; although these researches also revealed predictive value regarding present positive emotions. Concerning the predictive value of present emotions regarding future learning outcomes, the predictive value of enthusiasm regarding learning results has been displayed in previous researches [1, 15]; although these works revealed predictive value of negative emotions and other positive ones.

Table 2. Coefficients of correlation between the intensity of emotions prior to an active practice of Cell Biology and the previous knowledge of Cell Biology of Secondary Education level (pretest's mark). Bolds highlights significant correlations (Spearman, \*\*p-value<.01, \*p-value<.05)

Emotions prior to an active practice of Cell Biology	Correlation with Microbiology pretest
Joyful	.069
Trust	.079
Satisfaction	.071
Enthusiasm	.125
Fun	.121
Nervousness	-.062
Boredom	<b>-.157*</b>
Frustration	<b>-.227**</b>
Worry	<b>-.190*</b>
Uncertainty	-.011

Table 3. Coefficients of correlation between the intensity of emotions prior to an active practice of Cell Biology and the Cell Biology learning outcomes achieved after its implementation (postest's mark).. Bolds highlights significant correlations (Spearman, \*p-value<.05)

Emotions prior to an active practice of Cell Biology	Correlation with Microbiology posttest
Joyful	.114
Trust	-.089
Satisfaction	.067
Enthusiasm	<b>.157*</b>
Fun	.062
Nervousness	.074
Boredom	-.078
Frustration	-.054
Worry	-.024
Uncertainty	-.015

#### 4. Conclusion

Results show interactions between the emotions experienced by a sample of future Primary teachers, before and after the implementation of an active practical intervention of Biology; and their level of Biology knowledge, both previous and acquired with the implemented intervention. Due to emotions felt by teachers influence teaching-learning processes, these interactions should be taken into account in initial Primary teachers training.

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