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Contribution of inquiry-based physics teaching and learning in initial teacher training

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Contribution of inquiry-based physics teaching and learning in initial teacher training

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Abstract. Inquiry-based science education is an educational strategy in which students follow methods and practices similar to those carried out by scientists to build new knowledge. The objective of this research is to analyze the challenges posed by inquiry activities in the initial training of physics teachers. The present study was exploratory in nature. The sample consisted of 49 students. The data were collected through the Mathematics and Science in Life questionnaire, MASCIL (Maaß, and Engeln, 2016). The results showed that this strategy is rarely implemented in physics classes; However, when this occurs, both students and teachers benefit.

1 Introduction

The self-evaluation processes and the review of the science literature have revealed that it is necessary to incorporate different strategies for teacher training. For this reason, dynamic methodologies that involve students and teachers in inquiry tasks in real contexts are lacking. It is essential that, in the face of the new challenges of humanity, physics education also makes changes with a view to achieving a better performance of pre-service teachers in initial training.

Inquiry Based Science Education (IBSE) is an educational approach wherein students follow methods and practices similar to those carried out by professional scientists to build knowledge (Keselman, 2003). The IBSE is a causal process that allows the student to formulate hypotheses and test them contrasting them through systematic experimental activities and / or observations (Pedaste, et al., 2012). This approach emphasizes the participation and responsibility of students to discover the knowledge that is new to them. With this approach, students often carry out a self-directed learning process, part inductive and part deductive, doing experiments to investigate the relationships of at least one set of dependent and independent variables. For its part, for several decades science education has insisted that it is necessary to modify, or at least renew, science teaching methodologies. Likewise, this methodology has been important for the development of scientific thinking (NRC, 2000).

Several quantitative studies support the effectiveness of IBSE as a major approach in science education. Alfieri et al. (2011), for instance, conducted a meta-analysis comparing inquiry with other forms of teaching, such as direct instruction or unaided discovery, and found that inquiry-based teaching resulted in better learning for students (mean effect size of d = 0.30). Likewise, in a recent meta-analysis carried out by Furtak, et al., (2012) which incorporated studies that used a wide range of terms to describe inquiry-based learning (e.g., subject learning and constructivist teaching) with an overall mean effect size of 0.50 reported in favor of the IBSL approach when compared with traditional teaching.

2 Research methodology

The present research was exploratory in nature and was based on the analysis of the information provided by a group of students from a physics teacher training program. Data were collected from 49 students and 15 professors. Both qualitative (coding) and quantitative (proportions; non-parametric statistics) techniques were used. Quantitative data were collected through the Mathematics and Science in Life questionnaire, MASCIL (Maaß, & Engeln, 2016). This Likert-type questionnaire consists of 77 items. The information was made available on an online platform and then administered under the supervision of two researchers. The participants were students of the Licensure Program in Physics from the Faculty of Education of Universidad de Antioquia, Colombia.

3 Results

The results showed that the belief that students benefit from IBSL is significantly related to the routine use of IBSL in physics classes (see Table 1). On the other hand, orientation towards IBSL is also correlated with the belief that students benefit from IBSL. Consequently, this effect allows a greater disposition towards the IBSL,

in both students and teachers.

Description about the inquiry activities developed in physics class

Table 1 presents the descriptive and inferential results of the present investigation. Specifically, and for the case of descriptive analyses, the median and the absolute deviation from the median (MAD) were calculated. A comparison analysis of two independent samples was performed given the subscales of inquiry according to sex. The median and MAD values presented similar values for each of the subscales for the female gender (Me ± MAD = 2.87 ± 0.00), except for 'Application', 'Practical experiences', and 'Research', which had a MAD value = 1.00. In the case of the male gender, the median and MAD values presented similar values for each of the subscales (Me ± MAD = 2.75 ± 0.00). In 'Application', there was also a degree of variability. For 'Practical Experience', variables present differences related to the course taken. For the subscales 'Enjoyment', 'Inquiry Value', and 'Self-Concept', negative values were obtained (d = -0.064; d = -0.269; d = -0.121) respectively. This indicates that the female gender showed greater enjoyment in the inquiry activities than male gender.

Dimensions
(Subset of variables) Género p Value
U Mann -Whitney P Value Size effect (d)
Female gender. (N=16). Me±MAD Male gender. (N=33). Me±MAD
Enjoyment 2,87± 0,00 2,75±0,00 247.000 0.584 -0.064
Inquiry Value 2,87± 0,00 2,75±0,00 NaN -0,269
Self-concept 2,87± 0,00 2,75±0,00 NaN -0,121
Inquiry Interest 2,87± 0,00 2,75±0,00 286.000 0.586 0.083
Application 2,87± 1,00 2,75±0,00 295.000 0.493 0.117
Practical Experiences 2,87± 1,00 2,75±0,00 289.000 0.584 0.095
Research 2,87± 1,00 2,75±0,00 301.000 0.390 0.140
Table 1 Description about the inquiry activities developed in physics class

Conclusion

Promulgations of IBSL (Traditional Methods VS IBSE Methods). According to the results obtained, it can be considered that the facets of the IBSL have a relationship with the gender of graduate students in training, which can be supported by a marked correlation in categories such as 'Enjoyment' and 'Research'. On the other hand, an important facet is that of 'Self-concept', which needs more exploration. In the introduction it was mentioned that there are particular developments and expressions of each student from the IB approach. These particularities seem to have negative or positive statistical variability according to the course and the orientations of the teachers who lead each course. In other words, the IBSL has not only cognitive, but also sociocognitive and psychosocial facets.

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