New Perspectives in Science Education
International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION

Inter-University Project on Collaborative Physics Workshops: An Ibero-American Experience

RODRÍGUEZ-ARTECHE Iñigo (1), BARRETO-PÉREZ María del Carmen (2), MARTÍNEZ-AZNAR María Mercedes (3)

Universidad Rey Juan Carlos, Spain (1)
Universidad de Piura, Perú (2)
Universidad Complutense de Madrid, Spain (3)

Abstract

One of the essential aspects in the initial training of science teachers is to deal with the design and planning of experimental inquiry-based activities. In addition, the participation and communication in networks that help solve derived professional problems –aspects included in the digital teaching competence– is also fundamental. This paper presents an investigation with the participation of future teachers from Spain and Peru, in the context of the Primary and Secondary Education degrees, respectively. The purpose was to develop school workshops about physics, based on sequences of inquiry-based activities. The sample consisted of two class-groups of students engaged in subjects that include physics education. The work groups designed and published experimental activities for the corresponding workshops, including videos to facilitate their resolution. Then, after an initial session of videoconference, future teachers went on to solve and analyze the proposals of their partners from the other country. Throughout the process, the participants exchanged their reflections through forums and documents in a collaborative platform. Later, in another videoconference session, they had the opportunity to communicate their critical analysis to the work groups of the other nationality. Finally, they completed an online Likert questionnaire (1-5), on the contribution of the project to their professional skills and technical and personal contributions in this process. The results indicate great satisfaction from future teachers, especially accused in aspects such as: self-reflection on the designed workshops (69% of «5» scores), interaction with other future teachers (66%) or the perception of variety of materials to design inquiry-based activities (72%).

Keywords: *Preservice teacher training; Physics workshops; International projects; Scientific competence; Digital competence.*

1. Introduction

Nowadays, teacher training programs for any educational level are based on the promotion of professional competencies. Among them, it is necessary that future primary and secondary school teachers modify their teaching approaches, from the traditional ones focused on the teacher to other alternatives focused on student learning.

International institutions have highlighted the benefits of the «inductive approach» to promote students' interest in their learning and improve the quality of educational processes [1,2]. These methods, which include Inquiry-Based Science Education (IBSE), emphasize the construction of knowledge by students and the teachers' role of guiding, through an adequate «scaffolding». In this sense, the initial training of teachers must ensure their acquisition of skills to implement these methodologies and contribute to the desirable educational change. To that end, it is necessary to work on aspects such as sequencing and contextualizing the activities, or choosing appropriate laboratory materials, skills which are included in the idea of scientific competence [3].

Another training component would be linked to technological competence –fundamental in an interconnected world like ours–, which can be developed through collaboration in national or international projects, framed in initiatives such as eTwinning or Scientix [4].

The ultimate intention is that future primary and secondary school teachers have the opportunity to learn in a self-reflective way those knowledge, skills and attitudes that they will have to implement in their professional development [5]. Due to its relevance in the school classrooms, the design of «science workshops» –an approach encompassed in the IBSE model– would constitute one of the contents to be developed in the training programs.

2. Purpose

The purpose of the general inter-university project –focused on the initial teacher training– is "the design and analysis of school workshops on light and color and electrical circuits, based on programs of inquiry-based activities".

In this study, the research objective is to analyze the contribution of the didactic proposal to the professional skills of future teachers, and the technical and personal contributions during the development of the different stages and activities.

3. Theoretical framework

Science workshops make up a methodological resource that in this case is directed towards physics and its teaching. In general, workshops assume the implications of constructivist methodologies, centered on students and on the combination of theory and practice –in many cases, experimental–. In this sense, they can be understood as a methodology of structured inquiry [6], where the topic is given and a sequence of questions is provided to guide and orient knowledge construction. For their development, polyvalent or flexible spaces, variety of materials and, what is more relevant, methodological changes are required [7]. From a logistical point of view, workshops require a set of class sessions for students to solve different activities in cooperative groups. During their implementation, it is important to promote the autonomy and self-reflection of students, through a scaffolding properly planned by the teacher. In this way, science workshops represent a methodology that promotes the students' interest towards science learning [2].

4. Methodology

Due to the characteristics of the study presented here, once the participants have been identified, a distinction will be made between the stages of the academic proposal and the project assessment by future teachers. The latter will be carried out in terms of the impact on their professional skills and in relation to technical and personal contributions in the development of the project.

4.1 Participants

The project has been implemented with two class-groups of Spanish and Peruvian future teachers who are enrolled in Primary and Secondary Education degrees, respectively. There are a total of 8 future teachers from Spain (average age 20.75, 6 female and 2 male, 2 work groups) and 21 from Peru (average age 20.57, 9 female and 12 male, 4 work groups).

4.2 Stages of the learning proposal

The project has been developed in different stages, which are represented in Fig. 1. The general idea is that, in addition to designing their own physics workshops –and face the associated challenges– the groups of future teachers can compare and assess the pros and cons of different workshop approaches for the same topic (electrical circuits or light and color). To this end, an exchange of workshops among the countries is promoted, as well as their resolution and feedback between peers, through forums on the platform –Schoology– and a final videoconference session. In this way, it is intended to provoke in-depth reflection on the design of the experimental workshops, while promoting digital competence (video editing, publication of materials, etc.) and communication skills of future teachers.

4.3 Analysis of the project assessment

The results we present here derive from an online questionnaire filled by the participants. It consists of 18 closed questions (Likert scale 1–5) which are organized in the following dimensions related to the project: *i)* pedagogical impact; *ii)* subject-specific impact; *iii)* human contributions; and *iv)* technical contributions. These questions are shown and analyzed (descriptive statistics) in Tables 1–2.

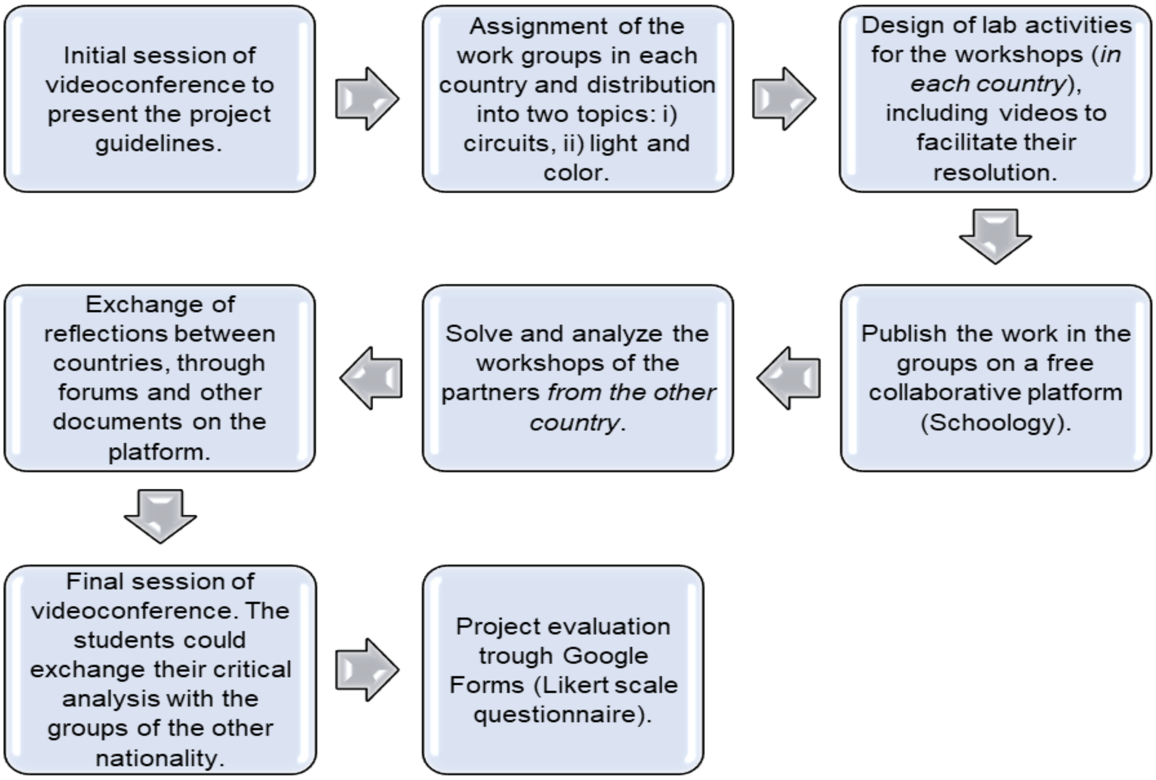

Fig. 1. Stages and activities of the inter-university project

5. Results

Tables 1-2 show the statistical results associated with the four dimensions of the Likert-type questionnaire (1-5). The first of them reflects that future teachers value in a very positive way the role of the people (work groups, professors, etc.) involved in the project. The technical and technological aspects also obtain high ratings, especially the final discussion activity through videoconference (item 8).

Table 1. Statistical results regarding human and technical contributions throughout the project

How much have the following aspects contributed to the proper development of the project…? (*N* = 29)					
Human aspects	**Min**	**Max**	**Mode**	**Mean**	**SD**
1. Your personal contributions to the different activities and work sessions.	3	5	4 (72%)	4.21	0.48
2. The contributions of co-workers –groups– of your same country.	2	5	5 (55%)	4.41	0.77
3. Professors from your own country.	4	5	5 (62%)	4.62	0.49
4. The associated groups –electrical circuits / light and color– of the other country.	3	5	4 (48%)	4.31	0.65
Technical aspects					
5. The design and tools of the Schoology platform.	2	5	4 (52%)	4.03	0.76
6. The videos made by the groups of the other country.	2	5	3 (41%)	3.62	0.96
7. The accessibility to the materials and tools necessary for carrying out the workshops.	3	5	4 (48%)	4.31	0.65
8. The final session of discussion about the workshops through videoconference.	3	5	5 (52%)	4.45	0.62

Table 2 includes the results on the pedagogical and didactic impact perceived by the participants. The second is slightly higher, highlighting aspects such as self-reflection on the design and selection of inquiry-based activities (item 7) or the diversity of materials to propose them (item 8). In any case, other transversal aspects (personal, technological or communicative) are also valued very positively.

Table 2. Statistical results regarding the perceived impact on future teachers' professional skills

To what extent do you consider that the project of school workshops between Spain and Peru has allowed you to…? (*N* = 29)

Pedagogical dimension	Min	Max	Mode	Mean	SD
1. Work and interact as a team with a group of future teachers from another country.	3	5	5 (66%)	4.59	0.62
2. Independently assess workshop proposals designed by other groups on the same topic.	2	5	5 (59%)	4.52	0.68
3. Constructively communicate the evaluations of the workshops designed by the other groups.	2	5	4 (52%)	4.24	0.73
4. Reflect on the own workshops based on the evaluations of the other country (achievements, mistakes, possible changes, etc.).	2	5	5 (69%)	4.62	0.67
5. Use digital tools to record and communicate information (video recording and editing, cloud spaces, collaborative platform, forums, etc.).	3	5	5 (55%)	4.52	0.56
Subject-specific dimension					
6. Improve personal understanding about the contents of electrical circuits / light and color.	2	5	5 (59%)	4.52	0.68
7. Reconsider the selection or design of lab activities to work on the contents of electrical circuits / light and color.	3	5	5 (66%)	4.62	0.55
8. Recognize that similar activities can be carried out with different materials (from everyday life, academics…).	3	5	5 (72%)	4.66	0.60
9. Recognize that the contents of electrical circuits / light and color can be sequenced in different ways.	3	5	5 (59%)	4.52	0.62
10. Identify and reflect on the inquiry-based or applicative –traditional– nature of the activities included in the workshops.	3	5	5 (62%)	4.59	0.56

6. Conclusions

The evaluation of the project supports its benefits to promote the development of professional competencies in future teachers, both those specific to science and others of a general nature, such as communicative or digital competencies. In addition, all of this is worked in a holistic way, through an authentic professional problem such as designing school workshops on physics.

Moreover, the perception of a variety of activities, materials or proposals to design inquiry-based activities is a clearly positive result, especially when, unfortunately, science workshops are still infrequent in school classrooms [1].

References

[1] Capps, D.K., Crawford, B. "Inquiry-Based Instruction and Teaching About Nature of Science: Are They Happening?", Journal of Science Teacher Education, 2013, 24, 497–526.

[2] Osborne, J., Dillon, J. "Science Education in Europe: Critical Reflections", London, The Nuffield Foundation, 2008.

[3] Hernández, M.I., Pintó, R. "The Process of Iterative Development of a Teaching/Learning Sequence on Acoustic Properties of Materials", In: D. Psillos, P. Kariotoglou (Eds.) Iterative Design of Teaching-Learning Sequences, Dordrecht, Springer, 2016, 129–166.

[4] Gozalo, L., Medina, C.J., Muñoz, A., Ortiz, C., Prestel, C., Rojas, D., Sayalero, B. "Nativos digitales, ciudadanos europeos. La acción eTwinning como ejemplo de la educación en colaboración a través de la red", Icono 14, 2013, 12, 123–141.

[5] Martínez-Aznar, M.M., Rodríguez-Arteche, I., Gómez-Lesarri, P. “La resolución de problemas profesionales como referente para la formación inicial del profesorado de física y química”, Revista Eureka sobre Enseñanza y Divulgación de las Ciencias, 2017, 14, 162–180.
[6] Wheeler, L.B., Bell, R.L., Whitworth, B.A., Maeng, J.L. “The Science ELF: Assessing the enquiry levels framework as a heuristic for professional development”, International Journal of Science Education, 2015, 37, 55–81.
[7] Silva, M.A., Fillat, M. “Los talleres de aprendizaje: una propuesta favorecedora de atención a la diversidad”, Aula de Innovación Educativa, 1997, 61, 51–54.