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Natural sciences in early childhood education: experience in using the academic poster

Carles Dulsat Ortiz

Humanities Faculty, Isabel I University, Spain, carlos.dulsat@ui1.es, ORCID ID: 0000-0003-1351-8506

ABSTRACT

This paper describes a study conducted in Bachelor of Pre-primary education degree classroom during a Teaching of the Natural Sciences class. It shows how poster may be used as a teaching and learning tool for natural science. The main motivation that guided the research was the fact that half the teacher trainee students had been removed from the natural sciences in their academic training for more than five years. It sets to approach the scientific concepts, but foremost it aims to go further in both scientific language adaptation or didactic transposition, as well as research and later exposition and presentation. It goes beyond the construction of scientific posters. The relevant elaboration of concepts related to the natural sciences is sought and to be able to explain them to their future children's education students. This experience has allowed collecting information by means of quantitative questionnaires; pre-test and post-test ad-hoc questionnaires were used, and complemented with a qualitative in-class observation diary. This one measured the students' participation. The qualitative part is analysed with the SPSS-22 software, while the qualitative data uses the dendrogram as an analysis tool. Through, this experience an increase in interest and motivation was achieved you need to state your conclusions more precisely, especially for the natural science subject, as well as introducing the use of the academic poster for its professional future.

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Introduction

The report *Percepción Social de la Ciencia y la Tecnología 2018* (Lobera& Torres 2019) [Social Perception of Science and Technology 2018] looks into popular Spanish view a regarding these topics. It was determined in this study that more than half of the population had a basic lack of knowledge regarding these two topics and a consequent disconnection towards them. The same happens with the students in Bachelor of Pre-primary education degree in the subject of Teaching Natural Sciences, who after an average of five years away from these subjects determine a certain lack of knowledge of these subjects, but the most serious is a certain cognitive distance with science and technology (Dulsat, 2019a). There is a lack of studies and experiences related to educational innovation related to experimental and natural sciences at the Pre-primary education stage (Campos et al., 2020). This research seeks to know how an activity under a more participatory methodology manages to bring the sciences closer to the students in a more experiential way, achieving, mainly, that the students are able to approach the sciences and be able to interpret in their professional future at preschool classrooms.

Knowledge of the immediate environment is one of the three main areas in the curriculum of Early Childhood Education [ECE] (M.E.C., 2007; M.E.C., 2008). During the first academic years of ECE, one of the main orientations is knowledge of the immediate environment. It is necessary to take advantage of this area as an introductory element of natural sciences to the pupils to bring their concepts of closer to affect the immediate environment. Posters can be something more than visual supports through which detailed, synthetic and graphic information is shown, but at the same time, they can be a didactic tool with which to bring knowledge to students. It is under this perspective that poster is used, because it tries to achieve a meaningful and experiential learning. For this reason, it tries to match other teaching strategies that achieve meaningful learning. In Dulsat (2019b), the use of microteaching for the acquisition of scientific knowledge related to ECE is shown. In this research, the students must act as teachers and prepare, adapt, expose and, finally, reflect together on the concepts of different scientific concepts. For example, the use of STEM tools is related to teaching technology in future teachers of ECE (Karademir&Yildirin, 2021). Another one, it's the design and elaborate a tale or short story with a certain scientific concept adapted to the students in the ECE (Dulsat & Rodríguez, 2020), or used a strategies and techniques to teach sciences in ECE (Adu-Gyamfi, 2020).

Presented these examples, the operation of the use of the poster is summarized. Mentioned below are the different steps and phases that are followed for the preparation of the poster and how the scientific knowledge is acquired. At the same time, they begin the search for suitable information to reformulate academic knowledge (scientific concepts in knowledge that are or can be understood by those who are deep in the material) or didactic transposition (Chevallard, 1991). The first step was to organize the students into several groups where each group chose the scientific concept to work on and think about the group of future pupils to whom the story of their tale could be addressed. The second step was to find information about the chosen scientific concept and start adapting it to a language more adapted to future pupils. In parallel, each group started designing the poster, searching for immediate environment where this concept could be found, and organizing the ideas and images in the poster.

Beside this didactic transposition, it should be noted that students in our study selected the concepts to be included in the poster starting from their own interests and previous knowledge (Ausebel Novak &Hanesian, 1983) with the restriction that they should be scientific concepts in immediate environment and avoid the repetition of concepts by several groups of our study. Chi and Roscoe (2002) contributed with added who understand previous knowledge as cognitive mechanisms that contribute to understanding and constructing reality, in a way how the they approach it, how they understand it, how they explain it. These authors develop a methodology to overcome the previous ideas by means of which knowledge is adjusted, new explanations of reality.

The poster is a tool used in teaching to deal with certain specific topics, in our case concepts from natural sciences, with the aim of promoting knowledge of certain subject to an audience (Fabre, 2004). In the formal and academic field, poster represents a graphical and textual means of portraying scientific work. It is considered a valid way of transmitting and transferring knowledge (Arslam et al., 2014); where two clear strands intertwine, a passive one. And where the poster is the physical element exhibited in front of the participants of a conference and an active one, determined by the interrelation and dialogue between the researcher and the audience (De la Cruz et al., 2016); and, also, the poster is used in different educational stages as a means of learning for the students (Reyes & Llanos, 2001).

Posters are used to boost the curricular contents considering a more active involvement of the students and achieving more intense educational experiences such as concepts transferring. The students are responsible for acquiring those concepts and the teachers accompanies and guides his students in the difficulties they encounter when preparing the information and communicating it to the rest of their classmates in secondary education (Coskum&Eker, 2018), or in PhD students (Lynch, 2018). As any tool, it has advantages and disadvantages. In the case of the poster (Guardiola, 2010), the positive aspects of posters are the possibility of using them at any given time, establishing direct contact with the authors and be able to resolve doubts directly with them, better comprehension owing to the visual nature of graphical representations, and visual appeal. Downsides in formal

contexts such as conferences include the inconvenience of viewing the poster and practical issues such as location in large rooms and the distractions they may provide. All of these disadvantages can be rectified when the organisation considers them. For the elaboration of posters, it should states clear messages. Therefore, the audience and their knowledge must be taken into account for a better understanding. And, lastly, it is artfully designed in order to enable an audience to derive a target concept from it designed it in order to obtain positive comments which must be responded in a positive in order to improve and perfect a future article (Sousa & Clark, 2019).

We must take into account the importance of existing objects in ECE classrooms as everyday elements that influence the routine and familiarity of the ECE pupil with the elements of the classroom. There, having the tools for poster construction by the teachers of this educational stage is important to fill the classroom with messages oriented towards the knowledge of scientific concepts or experimental sciences (Mourot, 2022), but it's necessary more study for the applications in kindergarten class (Marlot, Riat& Roy, 2022).

The objectives of this research were: (1) to contribute to the adaptation of the 'scientific language of the natural sciences in Bachelor of Pre-primary education degree students using the academic poster. (2) To show the achievements using academic poster as a didactic tool in the students of Teaching of Natural Sciences students.

Methods

The research aims at gathering information for future classes. In the use of more participative methodologies, where the student is more active in all learning stages of scientific concepts and their application in their professional future in ECE in order to decide whether the methodology fits several criteria which must respond the question: does the methodology of the academic poster fit the learning of the contents in students? For that, we will carry out criterial diagnostic tests in order to detect the validity and reliability of the new methodology to acquire knowledge in the subject (Latorre et al., 2005).

The design started out wondering how to bring students closer to natural sciences, since most of them had not been in contact with acquiring scientific concepts and set out to bring that knowledge closer for their professional future as teachers in ECE. Following the approach of Bartolomé (1984), the research design is adapted to the descriptive method. This design takes into account the complementary of the empirical- analytical perspective with the humanistic-interpretative perspective. The design of this research is oriented towards the relationship obtained from the data analyses. The use of the academic poster will be related to its influence on the development and learning of the students. In this way, it must allow decisions to be made regarding the possible changes to be carried out in the poster as a didactic tool.

Data were derived from a questionnaire administered at the beginning of the second academic semester, and another one at the end. Also, the observations collected in the classroom diary during the sessions related to the academic poster and tutorials carried out throughout the semester.

The research took place during the 2018-2019 academic year with all students in the second year of Bachelor of Pre-primary education degree in the matter of *Teaching of the Natural Sciences* in the Faculty of Science Education at the University of A Coruña in Spain. The matter is taught during the second semester and involves 12 mass sessions, 8 lab practice sessions, and 9 interactive sessions complementary to the master classes. All sessions were of 90 minutes duration.

Sample

The study population were the students in the second year of ECE programme during the academic course 2018-2019 throughout the second semester in the Teaching of the Natural Sciences' students taught in the Faculty of Science Education. This makes it a purposive sample since the

population is determine by the group of study (Ruiz, 2003).

The total number of students enrolled in the course was 68, 64 of whom took part in the research. Four of them chose distance learning and two of them did not show up throughout the course. The rest of the students were invited to the study, but finally only 43 decided to participate voluntarily.

Instruments

Two questionnaires were administered, one at the beginning of the academic year as a pre-test, and another one at the end of the semester, in the end of the activities related to the academic poster as a post-test. The pre-test consisted of 12 items divided into three sections with a reliability value of 0.857: (1) psycho-social characteristics of the students; (2) expectations of the course; and, (3) previous knowledge in natural science. The post-test questionnaire was made up of 12 items divided into two sections with a reliability value of 0.798: general achievements of the course, and the academic poster as a tool for teaching and learning. Both results of Cronbach's Alpha allow decisions regarding the data collected.

The researcher's classroom diary is used as a tool to take notes of everything that was happening. This instrument was part of the technique of participative observation, with a next coding system (Rincón et al., 1995; Valles, 2007). Moments in which situation related with the academic poster such as sessions dedicated to the presentation of academic poster were noted in the field diary, but also collecting all those moments in which any matter related to them took place, such as tutoring, questions in master classes especially or, generally at the end of the sessions. Virtual messages were also written down, be it the email or the Moodle platform used as a complement of in person education.

The classroom diary were coded. First, the different spaces in which students took part were divided: master class (C.M.), laboratory (Lab.), Interactive classes (C.I.), tutorial classes (C.T.), Electronic messages (M.E.), and another moments (O.M.). To this first coding was added a second level related to that which it makes reference to: master classes (cm), lab experiments (EL), tale (Cu), academic poster (PA), toys (Ju), Article reading (LA), field trips (SC), exam (Ex). These two big coding systems allow us to separate each one of the elements completed throughout the second semester and how those elements are commented in different class situations. And, they are complemented with a third coding to differentiate the groups, for example g_3.1 (Interactive 3, group 1).

Data Analysis

Quantitative data were analysed using a SPSS-22 software. Basically, frequency and descriptive analysis gave way to non parametric samples and hypothesis contrast to correlate pairs of elements and their sign range (Abad & Vargas, 2002). The dendrogram was used as a graphic representation for the analysis of the answers to open questions, which determined the existent relation between those answers. The class diary followed a descriptive observation, writing down everything that was happening, was commented of happened together with written messages sent via different telematics means. It was systemised once the observation was over with the coding appropriate to the didactic proposal, which was being implemented.

Findings

Students

The data producing sample has an average of 20.83 years, and they have an average of 4.56 years away from the natural sciences with a standard deviation of 2.41. Their initial expectations regarding the subject, the fields of interest in natural sciences, what was expected from the subject,

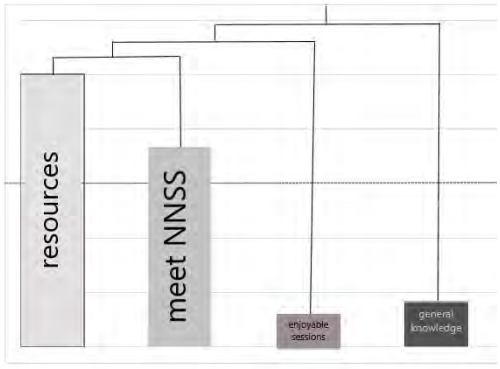
and the challenges they were expecting. As regards the motivation degree and the expectations on a scale from 1 –nothing- to 5 –everything-, the frequencies for motivation were 88.2% for the two higher values, a lot or everything, and none of the students answered nothing. Regarding expectations 91.5% ticked the highest values, a lot and everything, nothing that none of the students gave a low value, nothing or something.

In the initial questionnaire, it was asked about their fields of interest, *biology* at 37.4% being the most common answers, where it is included the human body, the flora and the fauna, ecology and nature. It followed by *physics* and *astronomy* at 27.2%. And, *chemistry* at 21,1%. Other answers were *geology* and *environment* at 6.2%; and, other responses with few representatives.

In regards to the answers related to what they were expecting from the subject it is noted that in figure 1 of the dendogram generated: 50% of them named aspects related to resources, activities, in-class work methodologies for ECE. They are followed at 36.6% of the answers, which mention relative aspects to comprehension, learning to know natural sciences. It must be noted that these two answers were related in the students. Finally, the less common answers such as entertaining classes with a 4.9% and gaining knowledge at 8.5%. From this data, it is interesting to note that a large part of the answers relate the desire to have resources to knowing the natural sciences, while the other two blocks of answers are far enough away and not related to the first.

Figure 1

Dendrogram, Answers to Suggestions



Note. Prepared by the author on the basis of N-Vivo 10

The challenges students think will have regarding the course are basic concepts challenges, be it having forgotten them due to not being in touch with the subject in a long time. At 31.3% followed by *organisational aspects and time* for the elaboration of classwork at 21.1%; 12.5% for the *lack of knowledge*; 10.9% for aspects related to language adaptation to ECE; 10.9% for experiments; 7.8% of the students thought that there would be no challenge; being creative at 4.7%.

The post-questionnaire presented two sections: in regards to the general contents where they were asked about the different *acceptation grade* of the subject, about their motivation and the achievements at the end of the course; and, a second one, in which they were asked questions regarding the academic poster as a didactic tool. Table 1 presents the results of the three grade regarding the general contents of the final questionnaire:

Table 1

Grade at the End of the Subject

Grade	*Acceptation*	*Motivation*	*Achieved expectations*
3	4,7%	4,7%	2,3%
4	44,2%	34,9%	62,8%
5	51,2%	60,5%	34,9%

The absence of values from 1, or *nothing*, to 2, or *something*, stand out, while 3, or *sufficient*, is the one with the lower percentage. That is how the sum of superior values 4, or *much*, and 5, or *all*, presents some results that represent over 95% of the collected data. Table 2 presents the summary of the percentages obtained:

Table 2

Grade Obtained Regarding the Use of the Academic Poster

Grade	*Acceptance*	*Interest*	*Achieved expectations*
1	0%	4,7%	0%
2	7,0%	4,7%	9,3%
3	20,9%	11,6%	14,0%
4	34,9%	41,9%	46,5%
5	37,2%	37,2%	30,2

It is noticed that the higher percentages are 4 or *much* and 5 or *all*, although the value 3, or sufficient have a great weight in the *acceptation grade*. In this case, the sum of the highest values is bigger than 70%. In the second part of the questionnaire related to the academic poster, it was also asked about the easiest and most difficult part in the elaboration of the poster. The data obtained was for the easiest part, preparing the poster at 55.8%, followed by its presentation at 23.3% and the research at 14%. The final answers were summarising and adapting concepts at 7% and the final observations of the activity with a 0%.

Regarding the most difficult part, the majority of the students answered research at 53.9%, followed by summarising and adapting concepts with a 27.9%. The final answers were preparing the poster at 11.6%, the presentation at 4.7% and the final observations at 2.3%.

The first part of the questionnaire asked questions about the challenges and feedback, while in the second part the questions were about the improving of the academic poster as a didactic tool. The percentages obtained for the subject were 45.9% nothing. 18% presentations in master classes for the technical language used. 9.8% the time necessary for the elaboration and organisation of the work. 8.2% explaining the work due to the lack of scientific knowledge. 4.9% the research, 3,28% field trips and adapting the language for children. And, 1.6% practice for their professional future, creativity and research of topics. Regarding feedback, 56.9% did not give any. 20.7% answered changing the percentages in the evaluation system of the subject. 8.6% organisation of the contents with less posters and more lab practice, realisation of topics, having more time between activities. Finally, as feedback contents applied to early childhood education with a 5.2%, more field trips and experiments with a 3.5%, and deepening in the vocabulary, handing in easier works and presentations with a 1.7%. In the feedback regarding the academic poster, 50.8% do not give any. While 13.1% suggest a bigger percentage in the final evaluation. Followed at 8.2% who suggest more time for the preparation of the presentations, having to present them throughout the completely academic year. The rest of the

answers are below 5% with answers regarding the anticipation of the activities, the realisation of topics to choose, improving the explanations for their completion, posters in other contexts, doing the posters at the beginning of the academic year or dedicating one whole session to the poster.

For all the variables, the null hypothesis of equal probabilities in results, a level of significance of 0,05% and a confidence interval of 95%. For the correlations, the Rho Spearman coefficient was used because the study was placed in nonparametric tests. There are 21 correlations between variable pairs, out of which there is only one between moments: the *motivation grade* of the subject at the end of the academic year with the expectations achieved with the elaboration of the poster at r=0,303. Correlations with high values to be considered are the ones obtained between the *acceptance grade* of the poster and the *interest grade* in the poster at 0.850. *Acceptance grade* of the poster and the *achievement of expectations* in the poster at 0.852; and, the *interest grade* in the poster and the *achievement of expectations* at 0.919. Another high correlation is between degree and age with 0,855.

Teacher

It so happens that it was in two moments of the master classes, the interactive classes and the lab, which the comments appeared: at the beginning of a class while the session was being prepared and while waiting for all the students to arrive and at the end of the class, the last minutes while the material was put away. No tutoring class was asked to talk about the academic poster, while electronic messages had comments on several different topics, never just one topic, let alone a message relating exclusively to the academic poster. As for matters related to the academic poster, they are divided in various aspects coded as follows: evaluation (Coe-f: co-evaluation and its functioning; Coe-c: co-evaluation and in-class comments during the evaluation of other groups). But also the evaluation of the subject (Ev-M). Time or timing of each session of the academic poster in the interactive classes (Tem). Removing science from immediate contexts (CCC). Poster format (For). Adapting the concept so it could be understood (Trans). Presentation (Pre). Organisation of the session (Org-s).

This coding allowed to collect information such as the doubts expressed about the headings of co-evaluation between classmates, and how to grade them. This information was collected from the days dedicated to the poster in interactive classes, once the headlines were handed to the groups and wanting to clear any doubt regarding the different sections and items of the heading presented. As the final exams approached doubts and observations regarding the percentages of evaluations and the structure of the very exam. Towards the end of the sessions dedicated to the poster and the master classes.

The timing matters of the sessions dedicated to the poster were explained at the beginning of the academic year and a copy of the organisation of the sessions (timeline) was uploaded to the platform for the entire group to access. However, electronic messages were received both on the institutional email, as on the platform one expressing doubts regarding the week and interactive groups. Those doubts also appeared as the first interactive class for poster presentation was approaching, both in master classes as in tutoring ones. There were groups that in tutoring that had doubts coming from different comments regarding certain classmates, which led to not knowing very well what was going to happen the week, sessions started. The tutoring classes dedicated to working groups had three compulsory tutoring classes for follow-up, in which doubts about scientific concepts in immediate environments were expressed: the home, faculty, neighbourhood chosen by the group. There were also doubts regarding the concept expressed prior to the didactic transposition, or adapting the scientific language to that which could be understood by the receiver. At the beginning of the first interactive session dedicated to the posters, doubts were raised about the organisation: what the sequence was going to be (g_1.3.), how long each group had for the explanation, how many group members had to present the poster (g_2.2.). Lastly, it stands out in the results obtained in the field diary. One group out of 14, g_2.3., wondered how could the poster be done digitally, which website allowed that format for the poster and how it worked. All of which was debated in a tutoring class for work groups to comment on aspects related to the poster and its elaboration. The groups had

doubts in the physical format and which materials could be used. In the end, all groups in the three sessions about the academic poster used paper combined with EVA rubber to present the posters in which, apart from the concepts they explained, had drawings and images portraying the concept and the chosen environment.

Discussion

Information from previous prior academic years (Dulsat, 2019a) together with that from the academic year in which the experience were carried out, show that the students of Early Childhood Education had been out of touch with natural sciences for years. In this case, 45.8% of the students had been out of touch with the subject for more than five years. Data shows an increase in the motivational percentage with the subject (Castañón et al., 2017) and for the achievement of these expectations from the beginning to the end of the course, although both were already high from the beginning. Motivation went from 88.2% to 95.4%, while expectation achievement went from 91%. There is a low correlation between expectation achievement at the end of the course and poster elaboration, and a high correlation between expectation achievement and the interest level. These correlations showing an increase in motivation and expectation achievement at the end of the course, together with the data on the acceptance of the subject at the end of the academic year was 95.4% and the acceptance of the poster was at 72.1% (all of these values were obtained by summing the 4th and 5th grade). It is observed, therefore, a higher percentage of subject acceptance, not so much in the use of the poster as a teaching tool. Besides, at the beginning of the academic year more than a third of the students were expecting to obtain resources and methodology they could use in the future, the expectation achievement being superior to 75% both regarding the subject, as the poster as a participatory methodology of work.

The truth is that of the most noteworthy obstacles, which a third of the answers given. 12.5% noted difficulties regarding the scientific concepts and lack of knowledge; although at the end of the year the suggested improvements regarding it. Only 1.7% ask to delve into the concepts and scientific vocabulary, being an improvement in academic performance and the achievement of teaching through this active methodology. It is the same that happens in Aramendi et al. (2014)'s study where active methodologies contribute to the achievement of learning. A percentage of 5.1% suggested implementing the academic poster as a didactic resource for the achievement of scientific knowledge.

It could be considered that, from the elaboration and preparation of the poster, its design, as the easiest task it. The students considered the three sessions and their corresponding weeks to be excessive because in some sessions the already had it ready and, especially, due to the observations noted, the students no longer asked for help in the last session before the presentations. Before, none of the groups presented from the information and communication technologies. Therefore, skills were not developed despite having the chance to do so. Other competences were developed, such as oral expression, in this case, since having the present the posters to the rest of the classmates, although the quantitative data shows that it is necessary to improve oral presentations, a small percentage voice in the improvement suggestions for the academic poster. The most complex task for making the poster was research. It is one of the competences to be worked throughout the early childhood degree and was found most difficult by the students. Another element students found difficult was language adaptation, the didactic transposition (Chevalard, 1991). Not only, because that is what the data from the questionnaire shows. But also because it was noted in the field diary, especially during the tutoring classes done with the different groups and it was highlighted as one of the most recurrent elements in the questions in those moments which were never tutoring classes or messages sent especially regarding the academic poster, let alone language adaptation, although it did show.

Taking into account the interests and previous knowledge of the students. They have been in contact with 15 different concepts of each of the sciences related to natural science. If we consider the high levels of achievement of expectations through the academic poster. 76.7% and the interest level for the academic poster. 79.1% in the two higher levels for both values (Ramos, 2017) with the

acquisition contexts and scientific concepts (López&Castaño, 2018). More than 70% of academic poster acceptance as a tool or resource for ECE was achieved.

The making of academic poster involved several of the competences developed throughout the ECE programme. There were certain shortcomings that could have been solved in the middle of the group of student suggestions. Time was one of those constraints and the most common one among students. There were also constraints in the co-evaluations carried out, both for the lack of comprehension in the first session as well as for the manoeuvres of some of the groups to favour themselves at the beginning and other group in the following sessions.

Conclusion and Implications

We could conclude this experience with a series of considerations. Revealing data was obtained as to a boost in motivation for the subject and bringing natural sciences closer to students:

- Considering the results, we could conclude that presentations could be reduced to a number of two with the making of one of the posters using information technologies and communication. This way, time would have been increased for the preparation of each one of the sessions. To this, we must add suggesting specific tutoring classes in the period of the making of the posters.
- Regarding research and scientific language adaptation, it is necessary to help groups since the elaboration seems to be most complex. For that, it is also necessary to extend the work with the didactic transposition as a tool, which makes it easier to adapt the content to the desired age.

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