INFLUENCE OF THE ROLE DEFENDED DURING A ROLE-PLAYING ON PRE-SERVICE ELEMENTARY SCIENCE TEACHERS' SCIENTIFIC KNOWLEDGE

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This work shows a study about the influence of the role defended during the participation in a role-playing game about nuclear energy on the pre-service elementary science teachers' scientific knowledge. 74 pre-service teachers participated in four role-playing games and a mixed approach was followed for data analysis, through a pre-test/post-test. The results suggest that the pre-service teachers who had to defend a role with a position against their personal point of view could achieve greater scientific knowledge learning. Furthermore, some limitations of this study are discuss.

Keywords: Initial Teacher Education (pre-service), Simulations, Socioscientific Issues

INTRODUCTION

In a systematic literature review of the Ibero-American education research context between 2010 and 2019, Grande de Prado, Baelo, García & Abella (2020) conclude that "there is an interest in the use of role-playing games in education, especially in Spain, but their potential is still to be development". In the last years role-playing games has been used in science education (e.g. Belova, Eilks & Feierabend, 2013; Craciun, 2010) but is less common its use in higher education, such as in teachers training, although role-playing games have proven to be useful in the treatment of environmental issues (e.g. Fox & Loope, 2007; Rueda, 2018). However, as Matas (2008) said, it is needed an evaluation of both role-playing game and its effects, otherwise role-playing game cannot be said to be useful as an environmental education resource. The aim of this work is to study whether the role defended during the participation in a role-playing game about nuclear energy affects to pre-service elementary science teachers' (PESTs) scientific knowledge learning.

METHOD

A mixed approach was followed (Creswell, 2014), and a quasi-experimental pre-test/post-test design with a mixed instrument was used for data collection. 74 PESTs belonged to four groups in the third year of the Degree in Elementary Education at the University of… participated in this study in 2018/19 academic year. Thus, four role-paying games were carried out. The scenarios of the role-playing games were developed through the simulation of television debates about the pact for the closure of Spanish nuclear power plants carried out by the Spanish Government and some energy companies (RTVE, 2019). There were five roles against the closure, five roles in favour and a neutral role as a presenter (table 1). The instrument for data collection included the following questions:

Q1. Do you agree with the pact for the closure of Spanish nuclear power plants between 2030 and 2035? (Close-ended question). Options: 1) I do not agree with the pact, I believe the use of nuclear energy should be maintained indefinitely; 2) I do not agree with the pact, the use of nuclear energy should be eliminated by 2020; and 3) Yes, I agree with the pact to cease the use of nuclear energy between 2030 and 2035.

Q2. Describe the whole process you think takes place in a nuclear power plant (open-ended question).

Q3. What is the name of the process of obtaining heat in a nuclear power plant? (Close-ended question). Options: 1) Nuclear fusion; 2) Nuclear reaction; 3) Nuclear fission; 4) Water evaporation; 5) Combustion; and 6) I do not know. (Option 3 is correct).

Q4. What gas do nuclear power plants expel? (Close-ended question). Options: 1) Carbon dioxide; 2) Helium; 3) Steam; 4) They do not expel gases; and 5) I do not know. (Option 3 is correct).

Q5. What do you think is being done with the solid waste produced in nuclear power plants? (Close-ended question). Options: 1) They are dumped into the sea; 2) No solid waste is produced in nuclear power plants; 3) They are buried underground; 4) They are taken to other countries to be managed; 5) They are buried underground, but stored inside concrete walls; and 6) I do not know. (Options 4 and 5 are correct).

For data analysis, disagreement and knowledge gain coefficients were calculated. On the one hand, the disagreement coefficient was calculated considering the deviation between the position on the problem that the assigned role had to defend and the initial point of view of each PEST marked in Q1. For instance, if a PEST had to defend a role against nuclear energy and they selected option 1 in Q1 in the pre-test, it was considered that the PEST presented disagreement with the role. In the same way, if a PEST had to defend a role in favour of nuclear energy and they selected options 2 or 3, it was also considered a disagreement. The number of PESTs who presented disagreement with a certain role was divided by the total number of PESTs who defended that role. This coefficient has values from 0 to 1, being 1 the maximum degree of disagreement. Values of the disagreement coefficient equal or under 0.5 were considered a low level of disagreement, and values over 0.5 were considered a high level of disagreement. On the other hand, knowledge gain coefficient was calculated with the answers given in Q2, Q3, Q4 and Q5. Q2 was analysed based on a basic scheme of the process that is carried out in the nuclear power plants consisting of six stages. The score for this question was calculated by adding the number of stages which PESTs could correctly identify. This result was adding to the scores obtained in the closed-ended questions (Q3, Q4 y Q5) to calculate the final score. Then these values were added by role, separately for pre-test and post-test, and the difference between post-test and pre-test was calculated and divided by the number of PESTs who defended each role. This coefficient has values between 0 and 1, being 1 the maximum degree of knowledge gain. Values of the knowledge gain coefficient equal or under 0.5 were considered a low level of knowledge gain, and values over 0.5 were considered a high level of knowledge gain.

RESULTS

Table 1 shows the disagreement and knowledge gain coefficients for each role.

Table 1. Roles' codes, roles' names, amount of PESTs who defended each role, position about nuclear energy which each role must to defend, and disagreement and knowledge gain coefficients.

Code	Role	PESTs	Role position	Disagreement coefficient	Knowledge gain coefficient
E	Ecologist	8	Against	0.13	0.43
RS	Renewable energy scientist	8	Against	0.00	0.39
C	Citizen	5	Against	0.00	0.88
SE	Solar energy entrepreneur	5	Against	0.00	0.63
OP	Opposition politician	2	Against	1.00	0.16
GP	Government politician	12	In favour	0.67	0.63
NS	Nuclear scientist	7	In favour	0.86	0.80
NPO	Nuclear power plant owner	8	In favour	0.88	0.51
NW	Nuclear power plant worker	5	In favour	1.00	1.00
NCO	Nuclear cemetery owner	10	In favour	0.90	0.41
P	Presenter	4	Neutral	--	0.23

The difference between the samples size of the roles are due to some PESTs did not attend the role-playing game session or they did not answer the pre-test, the post-test or both. There are six roles with a knowledge gain coefficient over 0.5, four out of which have disagreement coefficients over 0.5 (GP, NS, NPO and NW). In contrast, there are five roles with a knowledge gain coefficient under 0.5, one of them having a disagreement coefficient of 0.5 (E). Furthermore, four roles present high knowledge gain coefficients and low disagreement coefficients or vice versa. The role of the presenter is neutral and their disagreement coefficient was not calculated. The coefficients from table 1 are represented in figure 2.

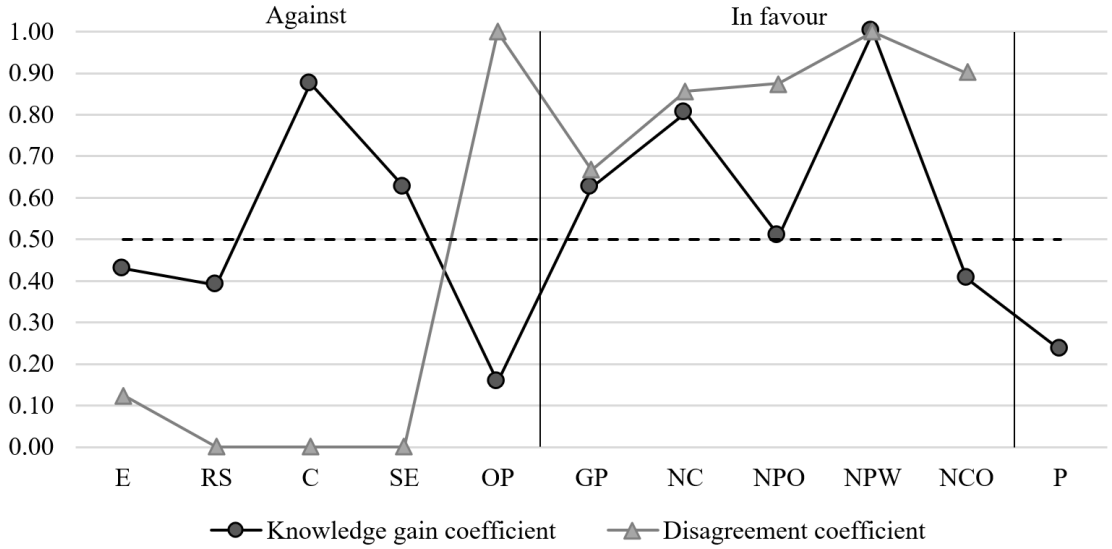

Figure 2. Graph of disagreement and knowledge gain coefficients by role. “Against” means roles against the use of nuclear energy and “in favour” means roles in favour of nuclear energy. Roles’ codes can be consulted in table 1.

DISCUSSION AND CONCLUSIONS

There are two groups of roles with respect to the variables studied: knowledge gain and disagreement. On the one hand, there are four roles in favour of nuclear energy in which PESTs had a high level of both disagreement and knowledge gain coefficients (GP, NC, NPO, and NPW), and two roles against nuclear energy in which PESTs had a low level of both coefficients (E and RS). On the other hand, four roles present contrary results to the previous ones, this means a high level in one coefficient and a low level in the other one (C, SE, OP, and NCO). Based on these results, the authors of this work have the hypothesis that PESTs with a personal point of view different from that of the role they have to defend will achieve greater knowledge. The existence of an effect of the role defended during the participation in a role-playing game on learning could be an important aspect to take into account for the design of role-playing games. However, the difference in samples size of the roles does not allow for reliable comparisons and no definitive conclusions can be drawn. Future works aim to achieve a more homogeneous sample in terms of the number of PESTs who represent each role and conducting statistical tests to verify the validity and reliability of the results.

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