Results of an Active methodology proposal for learning Physics: Experimental stations in the classroom for the investigative learning of Sound concepts in the 8th grade

Telma ESPERANCA, Maria José de ALMEIDA, Paulo GORDO

CFisUC, Department of Physics, University of Coimbra, Portugal

Abstract. This work is concerned with well-known difficulties felt by young students on dealing with Physics learning in schools. We have developed an active learning methodology aiming at the understanding of Sound by 8th grade students, mediated by the use of experimental tools in the classroom which potentiate a gradual building of successive correct cognitive structures. Aware of Physics teachers' difficulties, we purpose structured experimental activities which potentiate the curiosity and interests of young learners. The results of this learning project were tested with a sample of 359 students, divided among eight experimental' and seven control' classrooms.

Introduction

Results of school students' learning clearly show that the use of practical activities focused on everyday situations enhance students' learning about the nature of science [1,2]. Also important is the participation of students on the planning and execution of research activities, such as data collection and data analysis, well known competences of scientific nature [1,3]. However, these activities can be much more productive of students' understanding of Physics if preceded by a short introduction of physics concepts, the joint planning of possible experiments and the evaluation of eventual experimental results on different topics. This will allow learners to develop skills and competences to overcome possible future scientific unexpected results [4].

Methodology

This research work aims at improving students' learning results on studying Sound concepts on physics classrooms within the 8th grade. A specific strategy was developed to teach about 50% of the whole program on Sound in the 8th grade, in Portugal. The proposed teaching methodology was divided among four specific blocks: Mechanical waves, Sound propagation in different media, Mechanical waves and sound production, Challenges. A few experimental stations with different activities were prepared, which the students had to complete in a rotative sequence. The activities were structured following oriented inquiry principles, promoting students' understanding of simple physics concepts and motivation to search for answers to gradually further problematic situations. For the whole set of experiments, two distinct sets of written supporting materials were developed, one for students and another for teachers. On an action research perspective, we tried to improve the proposed teaching-learning methodology and contents, starting with a pilot study whose conclusions lead, cyclically, to a first study, an intermediate study and a final set of research products. Within every cycle, we have analysed teachers' and students' oral comments to the written supporting documents offered by the research team and the students' answers to final tests. This research study has been developed and sequentially tested along four academic years, enrolling a total of nine school teachers, seven basic

schools and 359 students. The research educational methodology is both qualitative and quantitative and the experimental and control samples used are convenience ones, not allowing an inferential analysis.

Results

Quantitative analysis of teachers' answers to questionnaires and interviews along this study, are very clear about the strong advantages of the present methodology: the development of students' curiosity, motivation and independence during the accomplishment of experimental stations within the classrooms. They further consider that experimental activities potentiate scientific and social competencies, mainly during group work. However, they have identified some group work difficulties, mainly concerning task management and correct answers negotiation. Table 1 shows the obtained results of the four experimental cycles, which ran along four academic years. The values of the classroom gains <g> were measured based on pre- and post- tests answered by the experimental and control samples [5]. Furthermore, along the study it became very noticeable that the evaluation post- tests from students belonging to control classrooms contained much more blank spaces (no answers al all) than the post- tests from experimental classrooms.

TABLE 1: GAIN RESULTS OBTAINED ALONG THE DIFFERENT RESEARCH CYCLES

Study cycles	Pilot	First	Intermediate	Final
Average <g> for experimental samples	0,26	0,39	0,53	0,69
Average <g> for control samples	0,03	0,18	0,21	0,39

Conclusions

Although one cannot claim an inferential validation of our study, due to the large amount of the teaching-learning uncontrollable variables, the obtained results evidence a progressive degree of correct meaningful learning both for the experimental and the control classrooms, although higher for the experimental classrooms. Hence the improvement of meaningful learning about basic Sound concepts based on designed experimental activities proved to be highly successful to prevent the development of well-known common-sense misconceptions by young students.

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