

# The Science Fair as a means for developing investigative skills in the elementary school

Evangelia Kyriazi, Constantinos P. Constantinou,  
Learning in Physics Group, University of Cyprus

A scientific literate person is able to argue in favour of specific theory by referring to evidence and the process of its acquisition. An important role for schools is to prepare future citizens to contribute productively in a scientifically literate and technologically dependent society. As a consequence, the development of scientific thinking skills acquires special importance in the context of learning in science in the elementary school. Investigative skills, as a means for promoting scientific thinking, can be developed in a learning environment in which both procedural and conceptual understanding are equally promoted.

The Learning in Physics Group at the University of Cyprus has a research program in which the science fair is being elaborated as a medium for developing investigative skills. The curriculum that was designed for the purposes of this research promotes student inquiry through a sequence of formal and non-formal activities. Students undertake authentic investigations related to simple questions from everyday life. They work collaboratively to implement an investigation in which they design experiments, collect data and formulate answers. The whole process culminates in a specially organised school event (*the science fair*) during which children display the procedures and results of the investigations and also engage in interactive activities that they have designed for the visitors. The

interactive activities, are developed by the children in collaboration with their parents in order to teach certain aspects of their investigation to other children and adult visitors to the science fair.

The main purpose of the research was to investigate if the active participation of elementary students in a science fair can lead to measurable changes in scientific thinking. In particular, the research focused on:

1. the changes in investigative skills brought about by students who participate in a science fair
2. the specific difficulties that hamper children's efforts to organize and implement investigative work and
3. the identification of possible interactions between investigative skills during their development

The research study was organised into three parts. In the first part, the students participated in a teaching intervention, which took place in a formal classroom setting. During the non-formal phase, the second part of the research, students implemented their investigation collaboratively and interacted with other students, their teachers and their parents in preparation for their participation in a science fair. The children formulated investigative questions, designed and implemented valid experiments, described their procedure in a notebook and created a

poster for displaying their methods and results. The third part of the program was the actual science fair.

For the purposes of the research, 29 instruments of assessment were administered to 35 5<sup>th</sup> graders in an elementary school in Cyprus (experimental group), before and after the formal teaching intervention and after the science fair. The instruments included tasks, which were designed to measure student's performance in investigative skills such as:

1. identification of variables
2. formulating questions
3. experimental design and control of variables
4. graphing data
5. interpreting data from tables and graphs, and combinations of two independent sources
6. identification of faults in experimental designs

Four of the questions were administered to the control group (5<sup>th</sup> and 6<sup>th</sup> graders) in order to compare their performance level for some of the investigative skills (1, 2, 3 and 4) with the experimental group.

Students' answers were analyzed phenomenographically. Both qualitative and quantitative results were collected. Qualitative results included performance levels for each investigative skill and specific difficulties that hamper the children's efforts to organize and implement investigative work. The results were further analysed statistically in order to determine significance levels for the following:

1. the differences in the mean score of performance between the pre-test, the mid-test and the post-test

2. the differences in the mean score of performance between the experimental and control groups

Finally, statistical analysis enabled us to determine any interactions between investigative skills at each of the three stages: pre-test, mid-test and post-test.

The results showed that active participation in a science fair by elementary students can lead to constructive development of investigative skills. Specific difficulties seem to hamper students' efforts to organize and implement investigative work. Such difficulties are discussed, especially with a view to informing the curriculum design process. Also, the differences in the mean score of the performance level between pre-test, mid-test and post-test were statistically significant. The differences in the mean score of performance between the experimental and control groups were also statistically significant. The interactions between investigative skills seem to increase both in number and statistical significance at the end of the intervention rather than at the beginning.

These results are discussed in the context of the development of scientific literacy for all and of the engineering of curriculum materials specifically designed to support this objective.