THE GAME "YOUNG SCIENTISTS" AS AN ACTIVE SCIENCE EDUCATIONAL TOOL FOR EXTRA-CURRICULAR WORK IN THE SECONDARY SCHOOL

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Abstract

In this work the results of organizing the scientific game "Young scientists" are shown. This game was carried out in three secondary and high schools in Bogotá with about two hundred students from 9th grade. Several groups of students were conformed in each school, which competed with each other answering a set of questions about mathematics and natural sciences, additionally the students carried out special tasks of consultation and experimentation in these disciplines inside the same game. Different teams of students competed answering questions and doing special tasks in this game. This activity, outside formal classes, showed positive results in increasing level of students' interests to study science subjects and provided space for raising motivation, working in group, learning stimulation and developing high skill levels in students.

Key words*: scientific game, young scientists, motivation, extra-class activities, team work*

INTRODUCTION

A lot of teachers and researchers believe that the learning of sciences in today's classrooms is too solitary and decreases the exhibition to a group of scientific paradigms that the student take as dogmas, avoiding the powerful social impact of the work groups, social discussion, and cooperation among the students. Based on this problem, the advantages of informal learning that take place inside and outside the school is emphasized, because students learn to build ideas with their own conceptual structures, confronting them with the experience; this is what the modern educator should motivate in his student (www.jnd.org/dn.mss/ComputerGames.html). One way to increase motivation consists on the inclusion of games to the teaching and learning process that can elevate the level of the students' commitment, to maintain low levels of tension, and to provide a proper atmosphere to learn and confront with the learned experience (Jensen, 1996).

Nevertheless, the inclusion of a game to the learning process should keep in mind many factors to obtain a positive impact in the student. First, it should be amusing and different aspects have to be involved, like individual challenge, the strategy use as well as the knowledge, anticipation, humour, cultural activities, etc. Second it should increase the development in active ways of thinking such as: analogical and creative thinking, identification of the attribute, critical thought, deductive reasoning, analytic thinking, etc. (Leigh, 2003/2004). To fulfil these requirements, teachers should carefully design game activities for teaching and learning.

According with the previously exposed, engaging students in enjoyably scientific activity beyond the normal curriculum is one important way to improve the quality of knowledge and skills and provide better motivation of students. There are different variants of science extra-curricular work for physics, chemistry, biology, mathematics and other science subjects: schools and national Olympiads, organizing science clubs and circles of interests in different topics of science subjects, research projects, outside visits and others (Baikova 1984, Roberts 2000, Orlik 2002). Scientific games represent interesting possibilities for science teachers in this way. These games can be organized in different modes such as: science theatre, games-exercises, science adventures, computer games in science (Navas, Orlik 2003). These extra-curricular activities can increase the interest and motivation of *teachers* in learning science – as well as those of their students.

One opportunity for using games in secondary school and university extra-curricular work is the application of games between different groups of students as a science competition. This variant allows the science teacher to develop in students important knowledge, skills of discussion, collaborative work, increase the desire to know more about science by reading popular science books, consulting Web and so on. This interesting mode of extra-curricular activities has been applied in different countries, for example, in former Soviet Union and Russia as special creative games (KVN) for the secondary school and university level students (current examples of this game exist in USA and EU too, for example, see , http://www.ligakvn.de/). The aim of this paper is to show the positive opportunities of organization of the scientific game "Young scientists" for students in secondary and high schools.

METHODOLOGY

The game "Young scientists" was organized in the different secondary schools in Bogotá in 2004 and 2005. The Group of Science education (GSE) of the Pontificia Universidad Javeriana (PUJ) has organized the game with these schools: Camilo Torres, Costa Rica, Palermo, Bethlemitas and some other schools. IBM Colombia was the sponsor of this game and provided t-shirts as the prizes as well as CDs with the introduction to the IBM educational site (www.tryscience.org). The Colciencias provided books history of science in Colombia as prizes for students.

The plan of this activity was:

1. Organizing the preliminary part of the game in 3 secondary schools, and the final between 3 secondary school teams held at the University.

To prepare the game, the staff of the GSE organized several meetings in advance of the game with secondary and high school teachers of science to explain the methodology of this activity. Then, with the participation of secondary school teachers and staff of the GSE, special scripts were designed for the preliminary part (Orlik, Gil, Moreno, Hernández 2005). These scripts included:

a. Science with 12-15 questions about this topic (mathematics, physics, chemistry, biology, astronomy). The level of these questions corresponds to the curriculum of these subjects for 9th grade. The questions contained original material that stimulated thinking, reasoning, creative reflection, team work, problem solving and other high level cognitive skills of students. 4- 5 special questions for the 'public' (the students who were not taken part directly in the game) were prepared too.

b. Additionally the participant teams prepared activities related with simple experiments of physics, chemistry and biology, which were exposed by the participants for their partners and professors, this activity was especially useful and of interest for students.

c. The cultural part of the programme includes 4-5 special activities for students with dances, music and songs.

The preliminary rounds of the game were organized in each secondary school as a scientific and cultural extra-curricular activity, and the school

administration arranged a special big room for that. From three to five teams of the 9th grade students participated in the game in each school. Each team included 10-15 students. A jury of 4-5 teachers provided the score for each question for the team that answered correctly and was responsible for managing this activity. Each question was showed on a screen and then all team had a short time (1 minute or more depending on the difficulty of questions) to write and send the answer to the jury for qualification. At the end, the team that got more points, won the game. The students from the winning team obtained special prizes as books, t- shirts, CDs etc. The representative of 'public' who did not take part directly, got prizes too when they answered their questions correctly. All student and teachers who took part in these activities were presented with a certificate from the school administration and the GSE.

Winning teams from the three secondary schools (10 -15 students in each team) took part in the final stage of the game in the Faculty of Science of the Javeriana University. In this case, the GSE designed a special script; the structure of this was similar to those for preliminary parts. Some questions from the final script are in Table 1. The final game was developed in a similar way to encourage active participation of students. Teachers from schools were present too with 10-20 students who did not take part directly in the game. The special jury included members of the GSE. The group of Palermo and Bethlemitas secondary schools won the game and gained the special prizes – a computer that was provided by the Faculty of Science of the Javeriana University and books for the school library.

Table 1
Examples of some questions from scripts

Explain the cause of the grey or black colour of many different cathedrals from the big cities built in marble (provide detailed explanation, if possible).
How can you distinguish uncooked and boiled eggs by simple mechanics experiments (provide detailed explanation of this experiment, if possible).
Why is sea water salty?
How can you obtain cheese from milk? (provide detailed explanation, if possible).

Students only used their own and group knowledge without consulting additional sources of information when they answered questions in the preliminary and final stages of this game.

RESULTS AND DISCUSSION

About three hundred 9th grade students from three Bogotá secondary schools took part in both stage (preliminary and final) of the scientific game "Young scientists". The difficulty of tasks and questions designed for that was of the intermediate level relevant to the contents of the corresponding curriculum and textbooks. Games were organized to provide opportunities for science competition between students of corresponding teams and for student who did not take part directly (the public). This aspect was positive and helped develop new social relations between students.

The observations of members of the GSE, teachers and participants allow us to say that this activity creates space for increasing the interests of students in studying science. The form of this activity is the game-competition and this aspect also stimulated active participation by students. It is important that this activity was not an individual competition (that is often the case, for example, in Olympiads). The participation of each student in team discussions when searching for the correct answer during the time provided stimulated their capacities and developed some important high level skills as the capacity to work in team, question that is not sometimes taken into account in the learning of the natural sciences and becomes a crucial ability for the scientific development of a society. It was important too that during the game, all participants could review their knowledge about mathematics, chemistry, physics, biology and other science subjects. Each student could also review their own capacity to find the correct answer in a limited time available.

The game was very useful for teachers too. First of all they took part actively in all parts writing and editing script materials and organizing the game in the respective secondary schools. The scientific and methodological quality of writing is very important in the first phase, because all the questions should be designed in such a way that it stimulate in the students' thought specific abilities as those referred previously, and they should also have an appropriate level of difficulty for the participants. Questions and tasks must be creative, provide incentive and should be linked with the real life; the boring variant and questions of poor quality must be avoided. In scripts both open and multiple-choice questions were used. A lot of effort by teachers with their students was spent providing a suitable environment for the game, preparing rooms, computers and multimedia, decorating rooms, preparing special written science slogans and so on.

For many teachers too, this game provided a lot of material and new experience to re-analyze their own class work and improve different parts of their educational process. All teachers who took part in this game expressed their desire to continue such and another similar extra-curricular activities for science education.

At the end of the game in each secondary school a questionnaire was given to the participants and their fathers to find the level of their satisfaction and opinions about this extra-curricular activity. Answers showed a high level of satisfaction with this game (95%) and desire to repeat this activity. Giving reasons for these positive opinions students and fathers noted the dynamic and amusing space of the game, opportunities for better science learning, informal organization and a change from the usual monotony of classes. In general they preferred *active* methods of learning.

CONCLUSIONS

The organization of scientific game "Young scientists" in the secondary and high schools showed an increase in the level of students' engagement and interest to study science subjects. This extra-curricular activity allowed provision of space for increasing motivation, stimulated students' capacities and developed high level skills. The format of the game is especially appropriated to foment work in group as well as the interrelation of the knowledge in physics, chemistry, biology, etc. for the realization of the different experiments carried out. When students participate in this kind of activities, the effectiveness of learning is reinforced. This activity can be recommended to teachers for increasing the level of educational process in science.

ACKNOWLEDGEMENTS

The authors thank the Vice rector office of the Pontificia Universidad Javeriana for support of this research in the project N 1938. The authors thank too the Dean of the Faculty of Science of the PUJ Dra. Ángela Umaña for her support and providing the computer as the main prize, the Colciencias, IBM Colombia office for providing prizes, teachers of secondary schools and the stuff of the GSE of the PUJ for the aid in this activities.

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