A PROJECT TO HELP STUDENTS WITH HIGH LEARNING ABILITIES IN MATHEMATICS IN SECONDARY SCHOOL: DEVELOPMENT AND RESULTS

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Abstract

In 2015, a poster entitled “A project to help students with high learning abilities in Mathematics in Secondary School: design and first steps” was presented at “INTED 2015”.

The main objective of the project was to pay attention to the talent of students with high learning abilities and to promote advanced skills and competencies in the field of creativity, innovation and research. Different activities were planned in order to achieve our objectives. Lecturers from the University of Castilla-La Mancha and teachers from several Secondary Schools in Albacete participated in the project.

After the project was launched, students from all levels of Secondary Education participated in the project. Two Secondary Schools from Albacete participated in the first edition (2014-2015) and other Secondary Schools joined the project in 2015-2016 and 2016-2017. Lecturers are greatly satisfied with the results of the project.

The aim of this work is to show development and progress of the project during these three years, to analyze results and to show achievements and challenges for the future.

Keywords: Secondary School, High Learning Abilities, Mathematics, Physics.
1 INTRODUCTION

Most of the projects developed in Secondary Education focus on students with learning problems and low level of curricular competency. However, needs of students with high learning abilities must also be addressed in order to reinforce the development of these abilities.

In academic year 2014-2015 we designed a project with the main objective of promoting advanced skills and competences in the field of creativity, innovation and research for students with high learning abilities in Mathematics.

This project aims to stimulate talent in Mathematics and Physics for students with particular interest and ability in this subject. It is important to detect this talent at an early age in order to support these capacities. Our project tries to put these students in contact with topics on Mathematics that are not usual to be studied in Secondary School.

2 METHODOLOGY

In Spain, Compulsory Secondary School consists of four academic years. Our Project selected 25 students from each academic year in the region of Castilla-La Mancha. Each group worked together with one or two teachers. Every week each group spent 1.5 hours working with the teacher on different topics on Mathematics or Physics that are not part of the ordinary curriculum. These sessions are developed outside school hours.

Students with the best results in the Secondary Math Olympiad of Castilla-La Mancha are interviewed and selected in order to participate in the project. Students that participate in the project in the first year of Secondary School are able to participate in the project until the last year.

At the beginning, students and teachers participate in a first meeting with the students' parents. In this meeting, detailed information about the project is provided and different activities in groups are developed.

During the academic year, different sessions are developed as we described above. Each session is organized as follows:

1. Presentation of the core issue. The teacher explain the main concepts and results.
2. Problem approach and problem solving. Exercises and problems are proposed to students to be solved.
3. Discussion of the results. Students share and discuss the results.
4. Strategy games with mathematical content.

Contents are motivating for the students and they are focused on solving problems using classical models (G. Pólya, J. Mason, L. Burton and K. Stacey, M. de Guzmán, and A. H. Schoenfeld). All of them promote personal strategies, reasoning and reflection of the process and the role of the mathematical knowledge to solve a great variety of situations. Therefore, contents are organized around two major blocks: subjects with free content (according to the preferences and knowledge of each teacher) and development of strategies of solving problems.

Some of the topics subjects are: Number Theory (divisibility, prime numbers and congruences, numeral systems, metallic numbers); Geometry (triangle geometry, non-euclidean geometries, fractal geometry; Introduction to Graph Theory; Counting Techniques; Order and Randomness; and Introduction to Cryptography.

At the end of each academic year, classes are completed with the development of global activities that may include a cultural trip.

2.1 Objectives

With this project, teachers aim to enhance and strengthen mathematical and physical knowledge in young people with talent and interest by Mathematics and Science, and train them in strategies and techniques of solving problems. In addition we would like to awaken the interest of our students in Science, and particularly, in Mathematics. We also would like to raise awareness on the importance of the education from early ages in order to improve our society.

Specific objectives of the project are:
Regarding the students
1. To detect students with high abilities in Mathematics and Physics
2. To stimulate positive attitudes and the special abilities towards Mathematics.
3. To contribute to the maximum development of their capabilities.
4. To promote the development of complex thought, skills and abilities that make them truly competent to understand, organize, and assimilate the provided information to apply it in practical situations.
5. To promote advanced skills and competencies in the field of creativity, innovation and research.
6. To provide the tools and personal resources to keep on learning and studying autonomously.
7. To deepen in the knowledge and use of new technologies (scientific calculators, mathematical software…) as sources of information and training tools.
8. To increase their curiosity and to foster their participation by means of intelligent questions and showing appealing mathematical strategies.
9. To provide networking opportunities with professionals and experts.
10. To give a humanistic vision of Mathematics through lectures and readings of historical and cultural papers.
11. To highlight the importance of Mathematics in the scientific development

Regarding the teachers
1. To organize a community of teachers with common professional interests and concerns.
2. To reflect on the needs of this kind of students: to adapt contents, activities and methodologies.

Regarding the education in Castilla-La Mancha
1. To contribute to consolidate the main Spanish education lines in Castilla-La Mancha.
2. To promote working together and to reflect about the practice among teachers in Castilla-La Mancha.

2.2 Development
According to the planning, the project has been developed during the academic years 2014-2015, 2015-2016 and 2016-2017 with new Secondary Schools from Albacete joining each year.

As an example, we show the activities performed in the academic year 2015-2016.

- January 2016: Dissemination of the project among the Secondary Schools. We provided information to the education team of the centers and information about the selection tests. Information was also published by means of local newspapers and e-mail.
- January 2016: Selection tests. Test assessment. Selection of the students who will participate in the project. Interview with the students and their parents.
- January 2016: One-day meeting with students, parents and teachers. Inaugural lecture.
- February to March 2016: Every Monday (with the exception of holiday periods) sessions are developed (1.5 hours per group).
- June 2016: Organization of scientific activities including lectures and a science camp.

All the activities were organized and developed by teachers from the Society of Maths Teachers and professors from the University of Castilla-La Mancha. With the exception of visits to museums and the scientific camp, all the activities were developed in classrooms of the Campus of Albacete (University of Castilla-La Mancha).

3 RESULTS
The assessment of the results was developed by two means:

1. Surveys that students fulfilled when the academic year finished.
2 Teachers evaluated continuously the project in the meetings during the year.

The experience for teachers has been very grateful during the three years. Therefore, nowadays a new edition for the next academic year is being prepared.

Results of the students’ surveys performed in 2016 can be summarized as follows:

More than 75% of students stated that the program reached or surpassed their expectations; almost 97% considered that learned some or a lot with the sessions and more than 78% of students showed high or very high satisfaction with the project.

They valued highly working in teams. In fact they stated that they prefer to work in teams.

Almost 84% of the students considered that sessions were enjoyable and amusing and 72% considered that sessions were easy or very easy for them. And more than 90% of the students found differences between the ordinary classes at the Secondary School and the classes we give in our sessions. They consider that the project helped them think and reason and they have improved their working style.

Teachers and colleagues were highly evaluated. 93.5% of the students were interested in continuing in the project the academic year 2016-2017.

As we explained above, the project is being developed the present academic year and results of this year will be also evaluated.

4 CONCLUSIONS

It is very important to develop projects to help students with high abilities in different subjects. Our project aims to cover part of this need. Students with mathematical and physical abilities were selected and our program has been developed with great satisfaction. Project, teachers, and colleagues have been highly evaluated by the participants. Our opinion and the response of the students encourage us to continue with the project next academic years.

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