1ST HANDS-ON SCIENCE SCIENCE FAIR

Zita Esteves, Manuel Filipe Martins Costa, Universidade do Minho, Portugal

In-school learning of science through investigative hands-on experiments is in the core of the Hands-on Science Network vision. However informal and non-formal contexts may also provide valuable paths for implementing this strategy aiming a better effective science education.

In May 2011, a first country wide "Hands-on Science' Science Fair" was organized in Portugal with the participation of 131 students that presented 38 projects in all fields of Science. In this communication we will present the main goals behind this initiative. The strategy employed problems and difficulties faced, as well as the solutions found will be reported. The evaluation of all the process is of utmost importance and will be discussed here including with the presentation of the statistical analysis of the students and teachers replies to participation surveys.

The science fair was considered a success by both teachers and students. A study was performed to understand the motivation behind students and teachers participation. Teachers were extremely pleased with their students' enthusiasm during the development and presentation of the projects and also pointed out the benefits to the student's school performance at the discipline directly related but also in general.

The students also demonstrated their satisfaction because they learned new concepts and acquired skills that helped them on the academic level. Almost all of them are looking forward to participate in future science fairs.

INTRODUCTION

Science fairs are cultural and pedagogical activities, hands-on based , where students have the opportunity to display and discuss scientific projects they developed actively (Grote, 1995) within or outside of their school context, in different themes (Bencze & Bowen, 2009; Ministério da Educação, 2006), and that allows the involvement of all the community (Ministério da Educação, 2006).

These activities allow scientific research in any science subject (Ministério da Educação, 2006) to be developed and interdisciplinary should be most welcomed (Bencze & Bowen, 2009). It facilitates the establishment of relations between science and daily life phenomena (Scheneider & Lumpe, 1996), helping students to understand the nature of the problem to be solved, gaining problem solving capabilities (Bencze & Bowen, 2009), make decisions, create hypothesis, and develop their creativity and imagination (Bencze & Bowen, 2009; Esteves, Cabral, & Costa, 2008; Ministério da Educação, 2006; Montes, 2006). They also develop others skills such as resilience and self confidence as well and social interaction (Sumrall, 2004) or communication ones (Montes, 2006).

To understand if and how this activity, highly regarded in many countries, could be successfully applied to the Portuguese students, the 1st Science Fair Hands-on Science was organized. Students from 5th to 12th grades (10 to 18 years old) were welcomed to participate.

THE ORGANIZATION OF THE SCIENCE FAIR

During the 2010/2011 school year, a national science fair was organized by the Hands-on Science Network[1], with the support of the University of Minho[2], and the Portuguese Association for Science and Technology Education [3]. The Science Fair toke place May 13, 2011, at the campus of the University of Minho in Braga, Portugal.

To publicize the initiative a website[4] was created, and the information was send to the official e-mail of all Portuguese schools and published at the website of the University of Minho.

On the fair' official website[4] important information was posted, such as the deadlines rules and support material. The participation at the science fair was open to all students from 5th to 12th grades (students with ages around 10 to 18 years old) from both regular and professional/ vocational schools. The participants were divided into 3 categories: students grades 5th to 6th, grades 7th to 9th and grades 10th to 12th.

Contribution were welcomed on all subjects of science. Students presented projects related to physics, chemistry, mathematics, robotics, environment, geology and biology. Interdisciplinary was encouraged.

Each group could have a maximum of 4 elements belonging to the same age category and at least one teacher as tutor.

The science fair organization was timed in 3 phases. The first phase, that lasted around 2 months, (until mid of January) students had to fill up a form with information about their project, such as the title, the main goal, a short description and a list of material needed. The organizing committee analyzed the projects and verified if they were appropriate for presentation at the science fair and if all the necessary conditions could be provided for each project.

The second phase runs until March 7, 2011. Until this date, students had to confirm their project registration or present any changes to the final project data.

Finally on science fair day May 13, of 2011, the students presented their works that were evaluated by the fair jury.

THE SCIENCE FAIR DAY

A total of 5 projects of 18 students, from the same school, were not presented at the science fair by economical reasons. That school communicate 2 days earlier that by economical reasons it was not possible to attend at the science fair day. Also, from the initial 46 subscribed projects, only 3 groups gave up as a student's option, as is possible to see on table 1.

Table 1 - Number of subscribers during all process

	Subscribers	Present at the science fair day
Groups of students	46	38
Number of students	160	131

1 www.hsci.info
2 www.uminho.pt
3 www.aect.pt
4 https://sites.google.com/site/feiradeciencias2011/home

At the science fair day the participants arrived at 10h30 to assemble and prepare the presentation of their projects. After a common lunch was all participants could informally interact, the fair was officially opened at 14h00 and lasted until 17h00. During that time, students had the opportunity to present their projects to others participants, visitors and to the jury.

The jury was confirmed by eight university and school teachers in physics, chemistry, biology, math's and arts, and was divided into four pairs of judges. Each pair visited and evaluated a number of projects. Each jury' pair was constituted by two teachers, one from the university and the other from an elementary or secondary school. After evaluating all projects, each jury pair reported to the ensemble of jury member. A number of projects were selected from each jury pair' favorites and were therefore visited by all the jury together with the purpose of selecting the best ones at the different categories. In each category, 1st, 2nd, 3rd prizes and one or two honor mentions were selected, as is possible to see on Table 2. At the end the awards diplomas and prizes were handed to the winning teams by the President of the School of Sciences of the University of Minho and the President of the Hands-on Science Network, at the closing ceremony. All students received participation prizes, such as HSCI t-shirts and caps.

Table 2 – Winning projects

Category	Projects
1st Category – 5th and 6th grades (ages between 10 to 12 years old)	1st Place – Pressure 2nd Place – Gas-powered boat 3rd Place – Handmade water treatment station Honor Mention – Explosion of colors
2nd Category – 7th to 9th grades (ages between 12 to 15 years old)	1st Place – "Espeolharium" 2nd Place – Low cost interactive whiteboard 3rd Place – Matinter@ctiva
3rd Category – 10th to 12th grades (ages between 15 to 18 years old)	1st Place – Greenhouse 2nd Place – A matter of balance 3rd Place – Electricity, did you as for? Honor Mention – Thermal paste Honor Mention – Seebeck effect of the atom to the Universe

RESULTS

To measure the opinion of teachers and students during their involvement on this activity, an inquiry was prepared and distributed.

Only 19 teacher's replies were gathered. Therefore it is difficult to draw significant conclusions. However, the opinion of all the teachers about the initiative was very favorable giving a good evaluation to the science fair event.

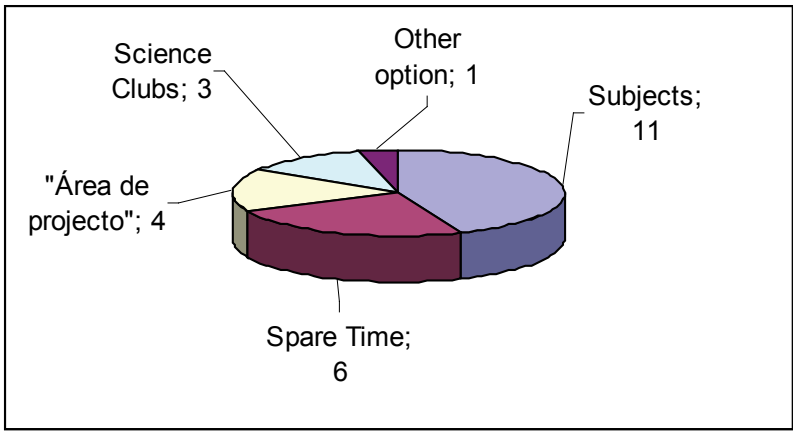

Figure 1 - Places where teachers work with their students

As it is possible to see on Figure 1 teachers mostly worked with their students during class time. The 11 teachers that mentioned having worked during classes pointed out to the involvement of classes of physics and chemistry. The other subject used was math (5 teachers).6 of teachers helped the students during their spare time. The others 4 worked at Área de Projecto, which is a curricular non-disciplinary subject, whose main objective is the development of projects.

All teachers agreed that they will repeat the experience if they have the opportunity. Only 5 of them would like to repeat the experience but with the collaboration of other teachers. The remaining prefers to work in the same conditions. That's easily understandable since these teachers already worked in a interdisciplinary way, as is possible to see on figure 2.

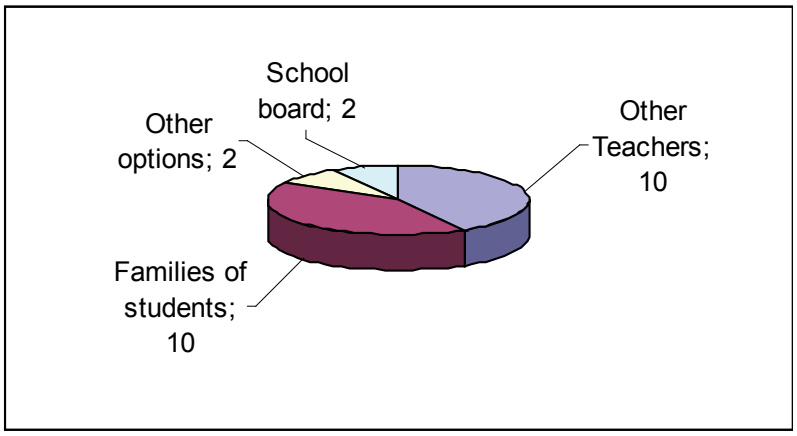

Figure 2 - Other collaborators on science fair projects

Only two of the tutor/responsible teachers worked alone with their students, the rest asked for the collaboration of other teachers. Due to the fact that the tutors were mostly physics and chemistry teachers they essentially looked for the collaboration of biology, informatics and arts teachers. On the other hand, it is possible to see that the student's families also had an important role on this activity. Also an engineer and a school employee were referred as collaborators.

From the 19 teachers that "coordinated" the projects with their students, 6 stated that worked less than 10 hours with their students, 4 worked between 10 to 20 hours and 9 works more than 20 hours. However, it is important to stress out that students work with other teachers, familiars and on their spare time without the coordinator teacher.

The question whether they think it is possible to develop this kind of projects during the classes, 14 of them said yes. The other 5 said that it is not possible due to curricula related time constraints. This is mainly a typical high school teacher's answer, since they strongly feel the pressure of "preparing" the students for the final exams.

Despite this fact, they classified their work with their students as a very positive experience and all of them agreed that their students worked with enthusiasm, effort, autonomy, accuracy and imagination. They agreed that the students benefited with their involvement on the subject of their project. However, they recognized that the benefits were mostly on the acquisition of skills, attitudes and knowledge.

Another inquiry was distributed to the 131 students that participate at the science fair. The first thing that we tried to understand was the reasons that made them participate, as is possible to see on figure 3.

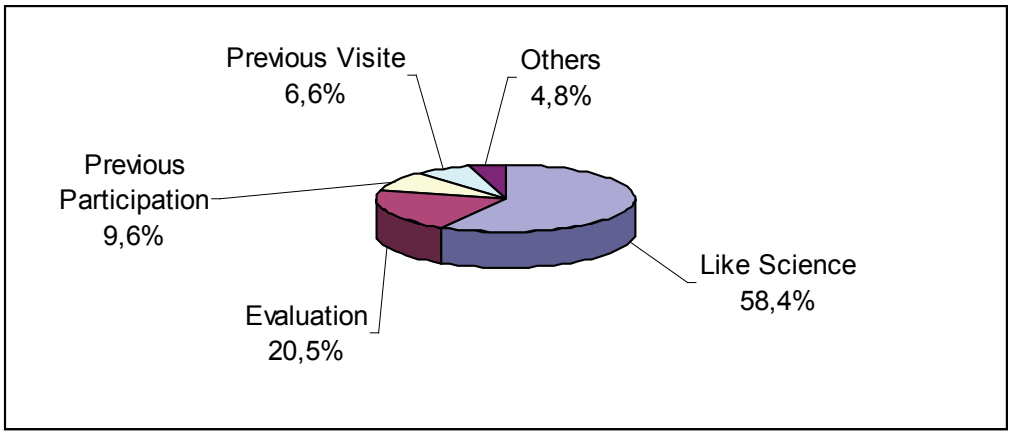

Figure 3 - Reasons presented by the students to participate at the science fair

The most important reason pointed out is the fact that students like science. However, 20,5% of them pointed out that they participated because they were evaluated. Despite that, from this group, 9,9% said that they also participated because they like science.

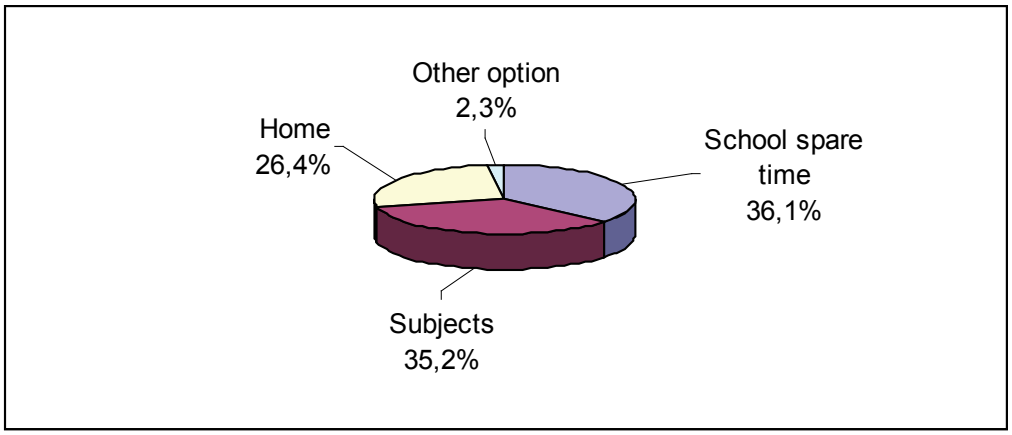

Figure 4 - Places where students developed the science fair projects

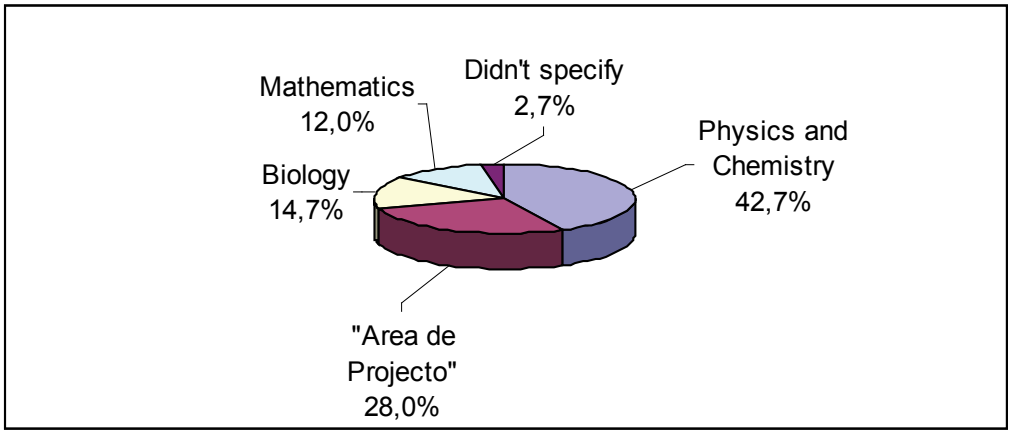

Figure 5 - Subjects involved on the development of the science fair projects

From Figure 4 we realize that the places where the students developed the projects were diversified since they had the opportunity to work at classes but also at school on their spare time, in clubs or even at home, with the support from their families and friends. The classes where students worked on their projects are presented at Figure 5. It is important to remember that some of the students gave more than one answer. However, the most popular answer was physics and chemistry, followed by "Área de Projecto" as already stated by their teachers.

The students reinforced the teacher's opinion that the science fair was a nice activity to repeat. 95,4% of them wanted to participate in a second edition if they have the chance. The rest 4,6% justified the fact of do not wanting to participate in other edition with the pressure they felt imposed by their teacher to participate and present a good work. Students stated that they learn many things with this experience. They learned concepts and acquire skills that feel can be useful in their lives as students.

Finally we asked the students to evaluate the event and the organization. The evaluation was favorable. The improvements that students pointed out were related to the space that should be larger and also on the projects evaluation. For example, students said that the same jury should visit all the projects. However, it is difficult to manage the available time.

CONCLUSIONS

Despite the science fair concept being still unusual in Portugal, the first edition of this science fair was very successful accounting with the expressed satisfaction of the participants, students, teachers and visitors.

Mostly due to practical constraint at their schools the number of groups that registered was higher than the number of effectively presented projects at the science fair day (Table 1).

The number of schools wasn't high, mostly from Minho region but yet spread across the country. It was clearly proved that this is an initiative that students and teachers like, feels as important and want to repeat. We expected that next year this event could become more popular and attract more schools.

All of the projects seems to had been developed in an interdisciplinary way, with the collaboration of teachers from different areas, such as informatics, arts, mathematics, biology, but mainly physics and chemistry. It is important to stress out the effort of this students, that spend most of they spare time at school, or at home, working on these projects also with the help of their family and friends. Time constraints curricula and specially exams' derived were among the most negative aspects conditioning students and classroom involvement in this kind of Science Fair projects.

FUTURE WORK

The 2nd Hands-on Science Science Fair will organize during the school year of 2011-2012 aiming also to select students teams to participate in international fairs like to one that will take place in Antalya, Turkey in October 2012 inscribed in the 9th annual Hands-on Science conference, HSCI 2012 . The fair will be advertised nationwide among schools teachers and students right at the beginning of the school year early September. The suggestions from the 1st edition fair' teachers and students will be taken in account in the fore coming organization and their opinion will be collected once more to further improve the statistical validity of the pedagogically relevant conclusions.

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