Using Physics to Innovate Practices in Family Type Firms

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Abstract. *One of the major causes that contribute to the increasing withdrawal of students from the education institutions is the lack of application of the studied subjects in the daily routines. There is a great gap between what is described in most of the compendiums and the request of the normal practical and technical works practiced in our society.*

Another frequent complain of our pupils is the fact that teachers always explain the theoretical fundaments, describe the development of motivating projects, but they never apply or concretize anything. This causes, frequently, a complete discredit of the teacher among the students and contributes to the growing abandon of school in order to search technical skills in the work market.

The objective of the project, here in presented, is to create a bond between teachers, students and their family by using hands-on experiments. This was achieved with a triangulation involving the clarification of the most interdisciplinary approach basics of light and optics and electricity focusing on the design and construction of simple technical devices such as a periscope, a solar oven or electric building equipment. These sets of experiences were useful to improve practices which are of common use in the workshops traditionally implemented in this disregard geographical area the school serves. The goal is to apply the in a widest range of traditional jobs creating more efficacy and profits.

Keywords: Electricity, Hands-on experiments, Light, School and Technical careers.

1. Introduction

This communication presents a project that aims to promote the creation of an educational space where the students can have an active role. At the same time, we pretend to improve the technical skills, the apprenticeship of our students and create the supports to employ this knowledge in their future labour. It was also our interest call the family to participate actively, in a way to show the importance of school and all the benefits that this cooperation could bring.

In the area where our school is settled there are great opportunities of employment in sectors relational with plumber, carpentry, electricity and bakery. Once there is a baker' professional course implemented in the school, we decide to turn our attention to other areas more related to our expertise in Physics and Chemistry. Since the beginning we thought that areas like light, optics, electricity and thermodynamics were ideal to our target students, in a way they could practice with the materials readily available in their parent's jobs.

The desire triangulation between teachers, students and parents was obtained. Every part had a desirable common interest. We had the teaching/learning process facilitated; the pupils have direct contact with practice and hands-on experiments, start to do the science on their own and contact with new instruments and science resources; and finally the local family firms obtain directly from their sons the capacity to submit an application of high-tech in their jobs and receive a better prepared and reliable workforce.

2. Student's Social Environment

The basic school of São Torcato is settled near Guimarães and it's inserted in a rural environment in the outskirts of this big industrial and historic town that belongs to the UNESCO's World Heritage Places.

The family aggregates are essentially constituted by small farmers and industrial workers. There is also a great percentage of unemployment and domestics. This fact, strongly affect school's activities and results, because the

pupils are generally not or residually motivated for study and even abandon school before the end of the minimum frequency of study defined by law in Portugal, which is high school.

Most of the times, this abandon is a result of major economical needs and aim to help their parents in their familiar small enterprises, normally, directed to service areas. Therefore, in Guimarães surrounding's we have a great amount of factors that contribute to school failure which is aggravated by the parent's disinterest to follow their son's school career.

3. Target Group

The set of experiments and its applications in the daily jobs was planned for pupils with ages between thirteen and sixteen years old that are in the 8th and 9th grade of the basic school. In the overall were involved more than seventy students coordinated by Physics/Chemistry teachers and with the cooperation of teachers from other different such as Mathematics, Informatics and English.

We also try to capture the attention of the whole community to be involved, by promoting a Hands-on-Science fair, included in the Science Week that concludes the study year.

Finally, it's also our intention to give a future seminar on our results to other colleagues, mainly, those related with Physics, Chemistry, Mathematics, Natural Science, Drawing and Informatics.

4. Brief Description of the Experimental method and experiments.

In the beginning there were constituted two groups of students, one from the 8th grade that dedicate to build some devices based in optics and light properties and another group constituted by their 9th grade students which worked in electricity and magnetism applications.

In the final, booth's experiences were crossed and their results were shown in the science fair that take place, each year, in June. The purpose of this dynamic workshop is to exhibit the school projects and demonstrate the local society the most important achievements obtained in the educational establishments of the area. About seventy students participated directly in this physics projects but about two thousand were, and still are involved in several activities that were requested because of the student's investigations. All devices that were produced were presented and explained by the students that point out their observations, analyzes, critics, and major obstacles in the processes.

The first stage was the motivation of the 8th grade students because the project implicate, not only work in the classroom but also dedication outside the timetable hours. We don't have a science club, so all the extra-curricular work was made in volunteer spirit and it was necessary to captivate the student's attention to science and technology.

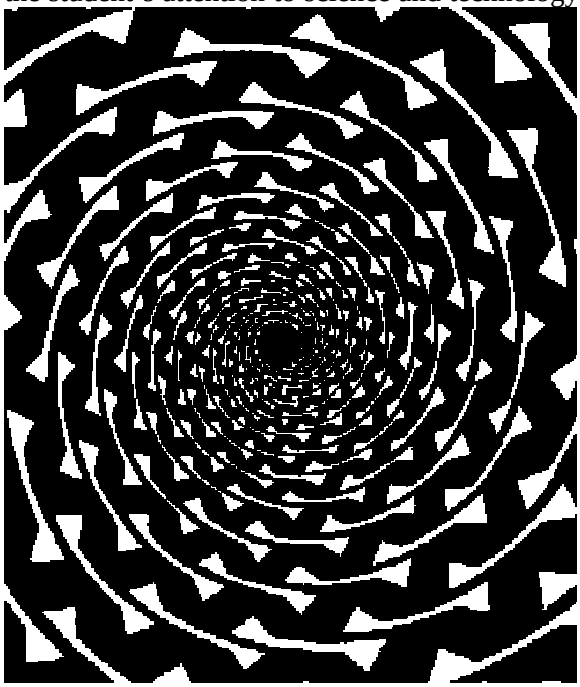

Figure 1 - Optical Illusion (Fraser's Spiral)

This motivation was achieved with a great success, by making an entertaining but educational work about large number of optical illusions (Fig. 1). The students worked in group and their task was to research in the web some light phenomena's and to explain them, in a critical and logical way, with the teacher's assistance. It was clear that our visual perception can deceive us because it's a reconstruction of the reality in our mind. The retina's stimulation suffers from inertia at the beginning and some luminous persistence in the final that can trick our examination (Fig. 2). These facts are crucial to explain the important role played by observation in the scientific process and to the potential of ambiguity of our inspection and the numerous and distinct errors that we are subjected to.

We gather up countless peculiar images that contribute to stimulate and to enthusiasm the pupils and also to explain the errors that we commit when we evaluate the size of circles, the high of squares, length of lines, the end of movements and the sensation of profundity.

Figure 2 - Optical Illusion (The Appearance)

Also to captivate the 9th grade student's attention and interest we help them build two types of electricity generators (Fig.3), one using the magnetic action, a dynamo, (introducing a magnet in movement in the interior of a coil) and the other with a chemical fundament (putting thin plates of zinc and copper in a few lemons).

Figure 3 – Chemical and Magnetic Generator

They were delirious with the facility to put electric charges in movement. An ordinary trick that experienced teachers use to capture the awareness of students is using experiments with an enormous visual outcome, some calculated risk and spectacular effects as possible, so we provoke a short circuit with iron straw at the terminals of a battery.

Another motivation factor is the fact that the most interesting and successful hands-on experiments are described in the school's newspaper with the photograph of the authors.

This favourable climate helped us to lead the students into some more complex tasks. The students were now left with total freedom so they could implement the hands-on experiments that most seduce them and were useful to their future career according to the family business.

The older students built an electric scheme of a house with large sort of components like, disjuncture, fuse, interrupter, lamp, commuter and so on (Fig. 4).

Figure 4 – A phase in the construction of a house's electric circuit

An electromagnet was also manufactured with the objective of being used as an electric derrick and other devices to expose the self-induction. They also, create am electric transformer with the specification needed to charge an old cellular phone.

Our desire was also introduce some high-tech materials that normally lack in the Portuguese school laboratories. So we made an effort and start to teach some basic contents about electronics that usually are never focused because they are at the end of the school physics program.

We use materials completely unknown to our students like diodes, LEDs, termístors, condensers, LDRs or transistors to assemble circuits assure automatic illumination, amplify the sound or constitute alarms that prevent fires or thefts (Fig. 5).

Their pawning was total because the goal of working and the competences acquired are of a

vital importance in a wide range of subjects they could apply in the future family job and also they were working with components that they never had access to.

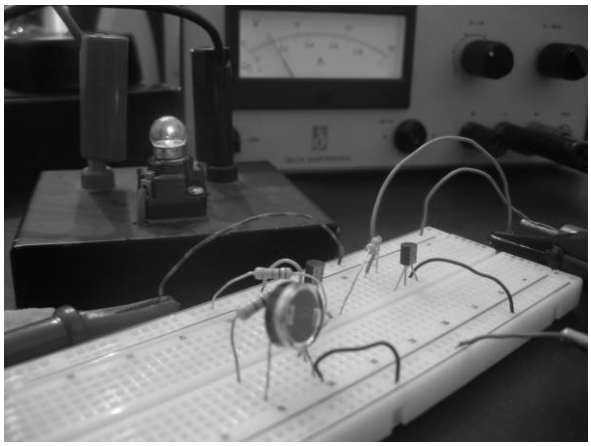

Figure 5 – An electronic circuit that assures automatic illumination.

The other group, with the younger students turn their attention to light and optics properties. They thought in an independent and autonomous way their procedures. The 8th grade pupil's imagination, creative spirit and the practical skills were put in the set of experiments. All the material were bribe by the students in their parents jobs and they use freely their imagination, creativity and the practical skills to conceive and design their.

They build a periscope that was used to explain the reflection laws and to do a little of spying.

Figure 6 – Analyzing the construction of the Periscope

They built also a solar collector that could be used to heat water and make a lot of experiments and measuring with it to understand subjects so different like the light waves, the sun orientation, the thermal material conductivity, the radiation absorbance, the heater effect. It was needed a great interdisciplinary work between Chemistry, Geography, Physics to explore all the potentiality of this collector.

Finally the two groups with students from different ages and school grades worked conjointly to share their knowledge's and to make an instrument that apply both electric subjects from the 9th grade with optical subject's from the 8th grade. The final result of this cooperation was the construction of an optic device that allows effectuating an analysis of the human visual system, namely, observing the iris behaviour, with the assistance of a lamp regulated by an electric circuit that contains a rheostat.

The labour and devotion evidenced by the students, the availability and time dispensed, the necessary tasks and diligences required and all the difficulties that they to pass over, gave them an enormous confidence and sense of responsibility. It has also revealed the teacher hided work that is necessary to present an interesting lesson and to prepare a set of hands-on experiments. In order to achieve the pretended results in a practice it is needed a lot of preparation time and the analysis of several factors that may influence the progression of the experience. For the pupils involved it's now evident all the factors that we have to account to reach to successful results and brilliant outcomes.

4. Conclusion

The students that were involved acquired special competencies in the focus areas and developed a critical attitude and the taste for study and the school space. The predisposition to observe the situations, analyze the problems, search for the solutions and implement the resolution process was increased.

Thanks to this program, now we dispose from vast panoply of pedagogical resources acquired by the school to fulfil the needs required for the project. Most important of all, we also create a large amount of didactic means that are used with very careful and proud because they are the fruit of the student's labour and imagination.

The most rewarding conclusion, from the statistics treatment of the inquests, is that science careers are now more desired. Sixty three per cent of the inquired reveal that science is now a part of their interests and priorities for the future. Having in account, that only eight per cent of the students followed natural-scientific area, in the last year, this is a promising notice and an inversion in the decline of the interest for science studies and careers.

Forty one percent of the students show improvement in science knowledge on the 8th grade optics subjects. The parents were also unanimous in accepting that this could be the right trail to explore in school. The bridges established between the educational system and the workforce brings to school there most important role and function in the society, creating exemplar citizens and excellent professionals and technicians for labour.

Finally, all the inquired were unanimous in reveal that the role of the sciences teachers is very important in their formation, because it's the area that gives them more technical skills and divulge the most important advances and applications useful to innovate the local business and small industries.

We can resume all this achievements by translating the words of an important Portuguese writer, António Nóvoa, "Education it's done in the production and not in the consumption of knowledge".

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