DEVELOPMENT OF EDUCATIONAL MATERIAL USING THE EXPERIMENTS CONDUCTED BY STUDENTS IN PRACTICAL PHYSICS CLASSES IN ENGINEERING COURSES AT THE STATE UNIVERSITY OF MINAS GERAIS - DIVINÓPOLIS CAMPUS

Alessandro Leonardo da Silva [1], Marcelo Robert Fonseca Gontijo [1], Ícaro Viterbre Debique Sousa[1], Heron Viterbre Debique Sousa[2], Thaís Prado Vasconcelos[1], Ivana Prado de Vasconcelos[1], Artur Saturnino Rodrigues[3], Rodrigo Silva Fonseca[1], Láila Eduarda Oliveira[4], Jaqueline Aparecida Melo[4]

[1.2,3] Teacher, Universidade do Estado de Minas Gerais, Divinópolis - MG, Brasil.

[2] Master Student in Metallurgical, Materials and Mining Engineering, Universidade Federal de Minas Gerais, Belo Horizonte – MG, Brasil

[3] Doctor Student in Biofuels – Universidade Federal dos Vales do Jequitinhonha e Mucuri, Diamantina – MG, Brasil

[4] Student, Universidade do Estado de Minas Gerais, Divinópolis - MG, Brasil.

alessandro.silva@uemg.br
marcelo.gontijo@uemg.br
viterbre@gmail.com
heronviterbre@gmail.com
thais.silva@uemg.br
ivana.vasconcelos@uemg.br
artur_saturnino@hotmail.com
rodrigo.silva@uemg.br
lailaeduardaoliveira@gmail.com
jaquemelo5668@gmail.com

ABSTRACT

Many authors address in their works the difficulty of high school students in absorbing certain concepts applied in the teaching of Physics only theoretically. One of the strategies incorporated in teaching projects in recent decades to minimize this problem was the implementation of experimental classes for the study of natural sciences in schools. Faced with this reality, the present project aims to facilitate the execution of some practical classes, so that quality teaching material is obtained and that can later be shared with teachers from our state high school network.

KEYWORDS: *Physics Experiments, Courseware, High School.*

I. INTRODUCTION

One of the strategies incorporated into national or international teaching projects in recent decades is the inclusion of experimental classes in the teaching plans of teachers within the study of natural sciences in Brazilian schools. Since then, such inclusion has occurred under different conceptions of science, teaching, and learning, because it has also been the subject of research in the area, under different theoretical references (Higa, 2012).

Many authors like Galiazzi (2001) present in their works several positive points that can contribute to the students' learning when the teacher acts by inserting experimental classes in their content. Among the main ones, we can highlight the stimulation of observation, the insertion of scientific thinking, the clarification of theory, verification of principles studied previously and the main one that is to motivate and maintain interest in the subject.

The result that is intended to be obtained when using experimental activities in the study of some disciplines depends a lot on how these activities are proposed and how the aforementioned presentation is developed with the students. This type of class meets its objective when it favors conceptual change, expands the construction of the concept of the discipline, in addition to promoting interdisciplinarity when the experiment also addresses concepts studied in other disciplines (Andrade, 2011).

Given the above, this work aims to catalog these experiments through photos, drawings in CAD-type programs and the elaboration of reports with their materials, objectives, procedures, and conclusion, so that at the end of the research we have quality teaching material and that can be shared with high school teachers in our state high school system. As a perspective for future works, a new stage will be conducted in order to bring this material to schools and perform demonstrations, a moment when students from our institution will demonstrate the importance of Physics in the study of Engineering with the help of this material, encouraging high school students in the search for understanding a discipline as complex for most students.

This work consists of developing a manual using didactic materials elaborated through experimental practices of physics with low cost developed by the students of the university with the objective of promoting the replicability of the experiments via DWG and perspective photos.

2.1. Theoretical Reference

According to Bassoli (2014), many teachers recognize the importance of experimental classes in the study of sciences, but many do not teach using this teaching tool due to lack of familiarity with this learning process, in addition to the lack of physical structure of a laboratory suitable for this type of class.

Practical Physics classes are a way to reinforce technical and fundamental knowledge. The professors at our institution, in addition to presenting practices already cataloged and available in kits, there is a culture of taking the student to elaborate and present practices developed or elaborated by the students themselves. This manual, in addition to reinforcing the experimental practices of the teaching institution, can also be used to improve teaching at various school levels and stimulate the learning of Physics.

To guide the work, experimental practices suggested from renowned textbooks such as AlVARENGA (2000), GASPAR (2000), SEARS et al (2010) and NUSSENZVEIG (2002) were used, with the aim of improving teaching and learning.

2.2. Materials and Methods

To start the project, the work team carried out the selection of experiments available in the Physics laboratories of UEMG at the Divinópolis unit in order to catalog these to facilitate reproducibility. Initially, ten projects from various areas of Physics knowledge were selected.

The next step was the search for high-quality photographs, from various angles of each of the experiments with the aim of giving the reader of the manual real clarity of the whole project.

The work continued with the obtaining of quotas using a tape measure and the making of the sketch of each experiment to facilitate the representation in AutoCAD. Several views were plotted in the Software, these being, top view, side, and front.

In the penultimate stage, a class script was produced containing title, objective, material, problematization, developments, formulas, and additional questions. The project was completed with the compilation and organization by area of a complete didactic material, containing class script, photographs, and plots of each selected experiment. The manual produced was delivered to the representative of the UEMG laboratory - Divinópolis Unit, so that it can integrate the laboratory's collection.

2.3. Results

One of the first results observed is that the compiled material managed to catalog experiments from various areas of Physics knowledge, such as Two-dimensional Motion, Hydrostatics, Statics, and Electricity. Figure [1] shows the experiment relating the collision to the horizontal launch.

Figure 1: Collision and launch pendulum

Source: Personal collection.

This experiment describes the collision behavior between spheres to determine the range of the projected sphere. The didactic airsoft experiment is shown in figure [2].

Figure 2: Didactic airsoft experiment

Source: Personal collection.

This experiment relates in a simple way the concept of pressure and constant volume. In Figure [3] shows the weight force work experiment.

Figure 3: Gravitational force work experiment

Source: Personal collection.

This experiment demonstrates the relationship between the work of the gravitational force and the mechanical power of the system. Figure 4 shows the experiment that didactically aids the visualization and behavior of two types of connection of residential lamps, three way and four way.

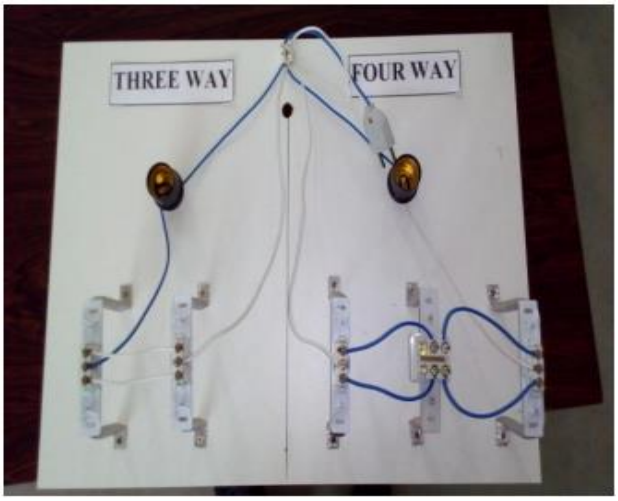

Figure 3: Three way and Four way experiments

Source: Personal collection.

This experiment didactically demonstrates the paths of electric current to visualize the open and closed circuit and the real operation of a lamp for a residence.

The proposal to represent the quotas and views in AutoCAD Software, envisioning the possibility of facilitating the reproduction of the mentioned experiment, is a result that also reached its object, as it ensures the reproducibility of the experiment. Figure [4] shows the cross-sectional dimensions using the 1:5 scale of the experiment shown in figure 1.

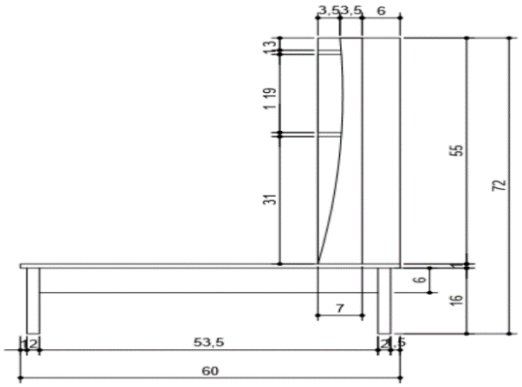

Figure 4: Cross-sectional dimensions of the Collision and launch pendulum experiment.

Source: Personal collection.

The layout of the manual cover presented in Figure [5] demonstrates the work team's care with the aesthetic and attractive presentation of the developed manual.

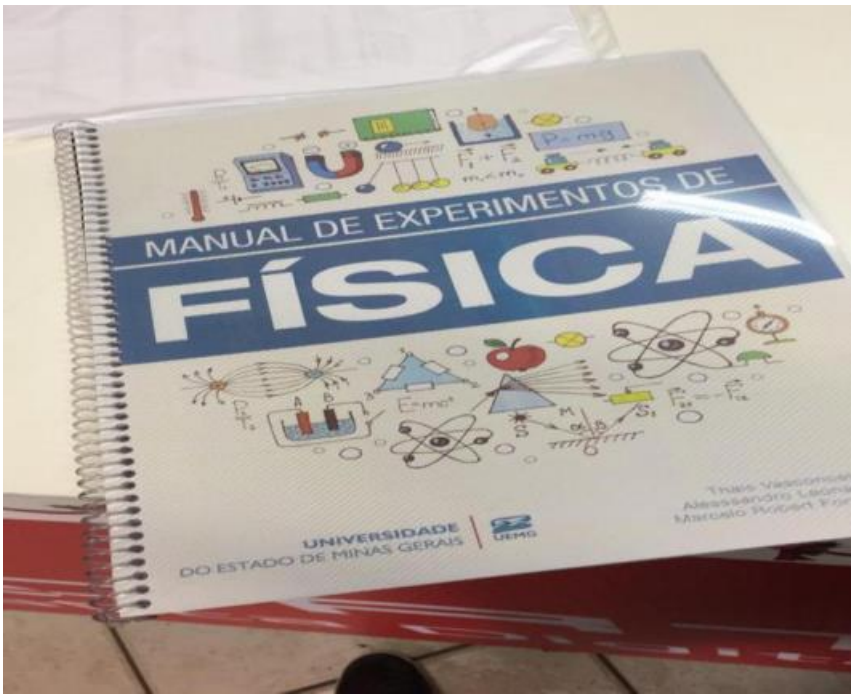

Figure 5: Cover of the developed manual.

Source: Personal collection.

Finally, the project fulfilled its main objective and handed over to the laboratory manager a copy of the manual produced during the project's duration.

II. CONCLUSION

High school Physics teachers have difficulties showing how theory is applied in practice, mainly because there is little material in institutions to assist them in this function. Thus, the need was seen for the creation of a didactic material with the aim of assisting Physics teachers, serving as a class script.

From the analyses made by the work team and the laboratory team, it was observed that the cataloged material will result in a significant contribution to the improvement of practical classes for the teachers

of the unit. In summary, the work team believes that with some improvements, the produced manual can in the future become a book and contribute even more to the diffusion of practical classes in the physics content.

In the future project, more physics experiments will be catalogued with new scripts and made available for free on social media.

REFERENCES

[1]. ANDRADE, MLF de; MASSABNI, Vânia Galindo. O desenvolvimento de atividades práticas na escola: um desafio para os professores de ciências. Ciência & Educação, v. 17, n. 4, p. 835-854, 2011

[2]. BASSOLI, Fernanda. Atividades práticas e o ensino-aprendizagem de ciência (s): mitos, tendências e distorções. Revista Ciência e Educação, p. 579-593, 2014.

[3]. GALIAZZI, Maria do Carmo et al. Objetivos das atividades experimentais no ensino médio: a pesquisa coletiva como modo de formação de professores de ciências. Ciência & Educação (Bauru), v. 7, n. 2, p. 249-263, 2001

[4]. HIGA, Ivanilda; DE OLIVEIRA, Odisséa Boaventura. A experimentação nas pesquisas sobre o ensino de Física: fundamentos epistemológicos e pedagógicos. Educar em Revista, n. 44, p. 75-92, 2012.

[5]. ALVARENGA, Beatriz e MÁXIMO, Antônio. Curso de Física, volume 1. Ed. Scipione, 2000

[6]. ALVARENGA, Beatriz e MÁXIMO, Antônio. Curso de Física, volume 2. Ed. Scipione, 2000

[7]. ALVARENGA, Beatriz e MÁXIMO, Antônio. Curso de Física, volume 3. Ed. Scipione, 2000

[8]. GASPAR, Alberto. Física. Volume 3. Editora Ática. 1a edição. São Paulo, 2000

[9]. SEARS, Francis Weston, ; ZEMANSKY, Mark Waldo, ; YOUNG, Hugh D. ; FREEDMAN, Roger A. Física I: mecânica. 12. ed. São Paulo: Pearson Addison Wesley, 2010.

[10]. NUSSENZVEIG, Herch Moysés. Curso de fisica básica 2, v. 1: fluidos, oscilaçSes e ondas, calor. 3. ed. São Paulo: Edgard Blücher, 2002