ENGINEERING EDUCATION FOR A VISUALLY IMPAIRED STUDENT IN THE PROFESSOR'S PERSPECTIVE: A CASE STUDY FOR THE PHYSICS DISCIPLINE

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Abstract: *The university teaching goes through a period of great changes and challenges to be achieved. In this context, the action of the professor has been reviewed the students are now active in their learning process and the teacher has to relearn what he understands by teaching and learning. The profile of students is also changing, the ones with disabilities are increasingly having access to higher education. This paper deals with the reflections and changes that occurred in the practice of a professor due to the presence of a student with visual impairment in classes of Physics I. Moreover, we make notes regarding the learning aspects of the other students who were benefited by those adaptations that were made in the materials so that the student had accessibility to the content.*
Keywords: *Inclusion. Engineering education. Physics.*

Resumo*: O ensino universitário passa por um período de grandes mudanças e desafios a serem superados. Neste contexto, a prática docente tem sida repensada, os alunos estão agora ativos em seu processo de aprendizagem e o professor precisa rever o que entende por ensinar e aprender. O perfil dos alunos também está mudando, os com deficiência estão cada vez mais tendo acesso ao ensino superior. Este artigo trata das reflexões e mudanças ocorridas na prática docente em função da presença de um aluno com deficiência visual nas aulas de Física I. Além disso, fazemos anotações sobre os aspectos de aprendizagem dos demais alunos, que foram beneficiados pelas adaptações que foram feitas nos materiais para que o aluno com deficiência tivesse acesso ao conteúdo.*
Palavras-chave*: Inclusão. Educação em engenharia. Física.*

1 INTRODUCTION

" You cannot teach a man anything; you can only help him to find it within himself".
Galileo

Brazilian higher education institutions are currently in a moment of restructuring. The expansion of the number of universities, the demands of the labor market and the new demands of society have changed over the last decades; the very role of knowledge accumulated by science, which justifies the existence of these institutions, undergoes significant changes. A higher-level diploma no longer appears as a guarantee or maintenance of employment, although, more and more, it is being demanded as a possibility to apply for a job (DINIZ, 2009).

The higher education offered in this new context must go beyond the understanding of the pedagogical act, based on the transmission of knowledge in the classroom and on grades conquered in tests and this adaptation is a challenge to be won by universities. (BORDAS, 2005).

By Cunha (2005), the mast of the of professors are not focused on developing intellectual skills in students, they are concerned about a better organization of content and not about procedures that allow students to map their own learning, that is, '*the good professor reports and references results of his research, but little stimulates the student to make his own study* '(op. cit., p.34), which is also one of the objectives of higher education.

The way in which the western world overestimates scientific knowledge and quantifies knowledge diminishes the importance of subjectivity in the construction of knowledge (CUNHA, 2000). The classroom should be considered as a place of construction, reconstruction and sharing of cultures (LIBÂNEO, 2005).

To demand a competent practice of the university professor is, above all, to recognize the importance of pedagogical aspects in teaching, without diminishing the importance of specific knowledge. However, most professors of higher education are not trained to practice the teaching profession, and even so, this competence is required, taking into account national parameters and career entry.

Most university professors do not seek the field of education research to better educate themselves. At the same time education departments, which are those conducting research in this field, often do not conduct research involving higher education and do not offer guidance to these teachers; furthermore, they present as justification the lack of receptivity and lack of interest in the challenge of changing their usual ways of acting (ZEICHNER, 1998).

According to Bordas (2005), in this context of university teaching, there is also a change in access to higher education, and the profile of incoming students has also changed. Thus, students with special needs increasingly become part, even if timidly, of this space. According to the School Census of Higher Education (2015) there were more than 38 thousand enrollments in higher education of students with some deficiency, of this total 23.75% had low vision and 4.95% were blind. Of this total number of students only about 13 thousand students enrolled and about 5 thousand students graduated. For visually impaired students, from the data presented in the Census (2015), of the total of 1922 enrolled only 33.9% began the courses and only half of them end the graduation course.

The lack of preparation of university institutions and professor may be one of the difficulties encountered by these students. And thinking about university teaching and the role of the professor in this context can be answers that help us understand the evasion of these students.

Understanding the difficulties of a visually impaired student (VI) is as complex as understanding the difficulties of a student seer in the classroom. The concern is to make a certain concept accessible to these students in general, what sets it apart is how this can happen. It is necessary to understand that the difference between the students with VI and the other students is in the construction of knowledge and not in the learning capacity of the student (SASSAKI, 1991).

Therefore, it is necessary to innovate the teaching process, to rethink the teaching practice and to reflect on the pedagogical knowledge of the content so that we can carry out different practices. Oftentimes these practices are in the concretization of the simple and the obvious and mainly giving active voice to the student so he can demonstrate what he needs to learn (MONTOAN, 1997; FONTES et al., 2012).

Thus, in this paper a teaching experience of Physics 1 in the course of Computer Engineering at the Faculdade de Engenharia de Sorocaba (Sorocaba Engineering College) is reported, where the presence of a student with IV in the classroom placed in reflection the process of knowledge construction and the line of teaching that the teacher sought to carry out in the classroom.

2. EXPERIENCE REPORT

The course of Physics 1 contains topics of Mechanics (Kinematics and Dynamics), and it is the first discipline of this area attended by the students. The main objective of the course is to prepare the students to describe and understand how movements occur and also to familiarize themselves with vector notations and the use of some mathematical tools, such as derivation and integration. We knew of the presence of the IV student in the class in advance and as a first intervention we called the student to talk and ask what he would need to make the knowledge accessible.

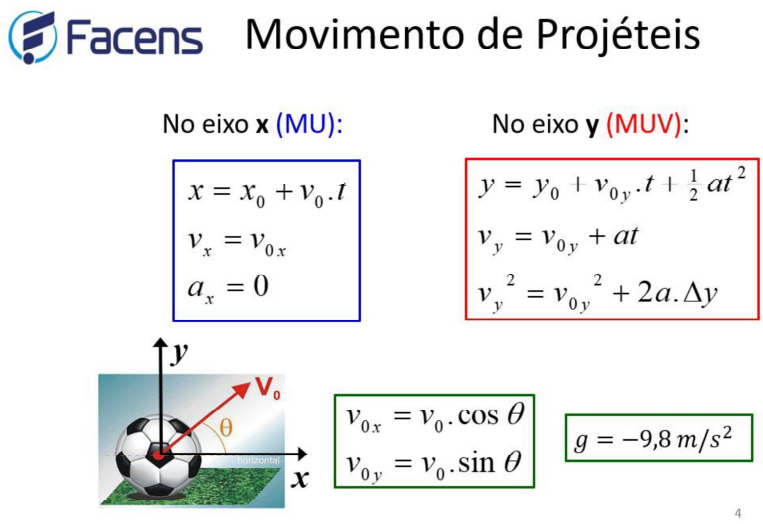
The student requested that the classes be fully described orally, and that in the math passages all the steps would have to be spoken. The equations would have to have subtitles. So we adapted the form of the lesson to be exposed so that the student could have access.

For instance, in the projectile launch class we made the adaptations (Figure 1) necessary for the student to understand the content worked. There was a concern in describing the equations as much as possible by the professors writing and speaking. Notwithstanding, the interesting thing was to realize that in addition to being successful with the VI student, the other ones also presented less difficulty in solving the exercises, understanding better the application of the equations in the resolutions of problems. This fact, according to the professor perception, is attributed to this greater care in the descriptions and transcriptions of this position, velocity and acceleration functions.

The figures were difficult to describe, some of them were made in highrelief before being passed on to the student. How to make this highrelief was researched in literature references and experiment with various materials such as hot glue, colored glue, etc. However, the best result was obtained with the use of a cotton cloth, used to make the figures (Figure 2).

Figure 1 – Material adapted for the VI student: a) conventional material; b) material adapted for the VI student..

a.



b.

Slide 4

A velocidade tem que ser decomposta nos dois eixos

FIGURA 4

V_0x = v_0*cos theta (velocidade no eixo x = velocidade inicial * cosseno do ângulo da velocidade inicial em relação ao eixo x)

V_0y = v_0*sen theta (velocidade no eixo y = velocidade inicial * seno do ângulo da velocidade inicial em relação ao eixo x)

g = - 9,8 m/s^2 (aceleração da gravidade = -9,8m/s^2) O sinal de negativo é devido a orientação escolhida para a análise vetorial.

No eixo x (Movimento Uniforme)

x = x_0 + v_0x*t (posição=posição inicial + velocidade inicial * tempo)

v_x = v_0x (velocidade constante)

a_x = 0 (aceleração = 0)

No eixo y (Movimento Uniformemente Variado)

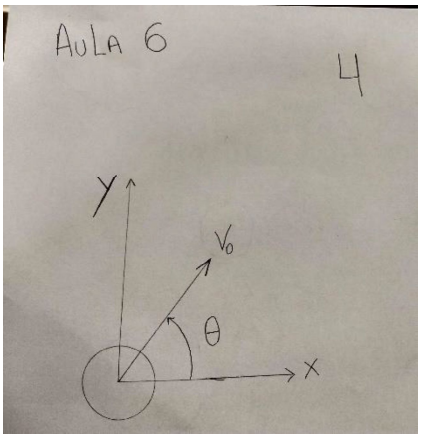
y = y_0 + v_0*t + (a/2)*t^2 (posição = posição inicial + velocidade inicial no eixo y* tempo + aceleração /2 *tempo elevado ao quadrado)

v_y = v_0y + a*t (velocidade = velocidade inicial no eixo y + aceleração * tempo

v_y^2 = v_0y^2 + 2*a* delta y (velocidade no eixo y elevado ao quadrado = velocidade inicial no eixo y elevado ao quadrado + 2 * aceleração * variação da posição no eixo y)

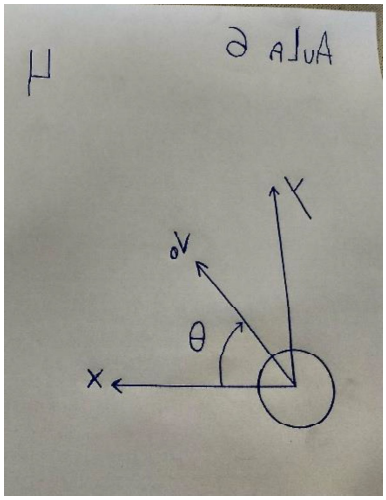
Source: produced by the authors.

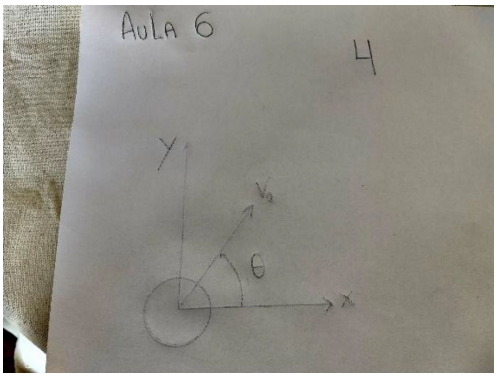
Figure 2 – Making the material with high relief.

a. 

b. 

c. 

d. 

e. 

f. 

Source: produced by the authors.

The alphabet and all the numbers, so he could 'read with his hands' the letters and numbers used in the graphics and figures made in the fabric, so only the Greek alphabet demanded a presentation using high relief. The movement graphics were also presented and highlighted in detail by the teacher in the classroom.

There were also group activities and exercises designed so that the student with IV could autonomously understand the problem and effectively help the group in the resolution. The test he

did was the same as the rest of the classroom, in which he got a grade above the average. The classroom as a whole had a higher average than other classes of Physics 1 of the same university. Although we can not say only with this fact that the student's presence with IV and the content adaptations were the reason for this higher yield, we can consider that in this process the way the classes were constructed and performed in the classroom implied some changes, such as the concern with the detailed description and physical significance of each item of the function. Therefore, such adaptations may have facilitated the learning of the students who presented a greater resourcefulness when solving the problems presented in the room.

3. FINAL CONSIDERATIONS

Physics 1 classes for the most part are classes with many calculations and analysis of functions to describe and characterize the movements of bodies. With the presence of the IV student in the classroom there was a modification of the teaching practice in order to make the content accessible to that one. It should be emphasized that making accessible does not mean facilitating the degree of difficulty of the discipline, but rather it has the same conditions of access to knowledge and the possibility of learning.

Thus, there was a greater detail of the content and some students benefited from the adaptation process promoted for the IV student. We know that learning occurs in different ways, and we can highlight the most common VAK (visual, auditory and kinesthetic) (SALDANHA, et al., 2016). Each student has a predominant style, but often there is a mix of the more than one style.

According to Saldanha (2016) students with a predisposition for auditory style are those who "*have the ability to know, interpret and differentiate the stimuli received by the spoken word, sounds and noises, organizing their ideas, concepts and abstractions from spoken language*" (op. cit., p.2). These students benefited from teacher reflection in their practice to make it less dependent on the vision.

In this sense, then we can highlight that inclusion can be seen as a process of enriching teaching practice, as a trigger element to revise our practice, which is often much addicted to old customs and practices. The presence of a visually impaired student took the professor out of his comfort zone and brought him to a process of reflection and adaptation of his practice.

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