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"PEDAGOGICAL APPROACHES FOR TEACHING PHYSICS"

Education

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ABSTRACT

Different teaching approaches have revealed that teaching physics is a complex process, a profession that must adapt to the specific needs of the learners, the nature of the subject taught and the general context of the training. However, the act of learning is a common activity. In the educational sciences there is no one-sided approach to the didactics of physical sciences. Therefore, teachers of the physics are invited to choose the appropriate pedagogical approaches based on the performance and limitations of each approach. In this article, we will review the literature of the main pedagogical approaches used to facilitate the acquisition of physics. On the basis of this study, we will highlight the added value of the combination of a relatively recent approach, based on historical investigation and simulation.

KEYWORDS

Pedagogical approaches, simulation etc

INTRODUCTION

The problem of learning and the teaching of sciences is worrying. It has been subject to debate for decades (Chekour, Laafou, & Janati-Idrissi, 2015b). Around the world, there is a decline of youth interest in science. There are diverse and complex reasons why young people are not interested in science (Griethuijsen et al., 2015; Leal, Leal, & Fernandes, 2010). Legendre points out that the abstract nature of scientific knowledge hinders the acquisition of scientific concepts (Legendre, 1994). Research shows that the source of the problem lies in the difficulty of achieving the objectives of experiments in laboratories (Hofstein, 2017). Other researches emphasize the danger of learners' conceptions in the teaching and learning process (Taber, 2017). From another perspective, studies have shown that the problem lies not only in the knowledge itself, but also in the teaching practices (Ma, Fulmer, & Liang, 2017). For this reason, several researchers were interested in the development of pedagogical approaches to make effectively teaching science and to increase learners' motivation (Chekour, Laafou, & Janati-Idrissi, 2015a; Heering & Höttecke, 2014). Fayolle and Verzat (2009) identify three main stages in what characterizes the general evolution of teaching approaches: they observe a shift from traditional logic of mere transmission of knowledge, to a logical transfer of capabilities with the Objective - based approach, then a logic of developing skills through practical training. In parallel with these three main stages, the project- based approach and the problem-solving approach have taken a remarkable place in the work of didactics, especially in the learning of scientific disciplines. In this article, we will discuss the literature of the main pedagogical approaches to make the so-called hard sciences more attractive. This discussion presents the advantages and limitations of each approach. The objective of this work is to contribute to making the physics more agreeable by investigating in pedagogical approaches and in educational technologies.

Objective Based Approach

The objective-based approach is still very present in all fields of education (Bates, 2015). Historically, this pedagogy was founded by Ralph Tyler in 1935 (Sardo-Brown, 1990). A learning objective is a statement of intent that describes what the learner will do after learning (Raynal, Rieunier, Postic, & Françaises, 1997). Objectives are presented as students' behavior. Thus, the formulations of these objectives refer to activities from the point of view of the student and not from the point of view of the teacher's project, which is a similarity with the behaviourist theory that is concerned with the study of observable behaviors of students. In this approach, the objectives are broken down into general, specific and operational (Mager & Décote, 1971). Students' success in this approach depends on the achievement of specific objectives. However, the majority of these students lose the thread in their learning. Indeed, the objective-based approach does not offer global tasks and therefore does not offer learners a global view of what they are learning.

Competency Approach

Carette, Defrance and Kahn (2006) argue that there is a difference between competency and pedagogy-based approaches. This latter invites student to work on operations that are too partial, which does not allow them to grasp the meaning of learning. On the other hand, the competency based approach is committed to making pupils work on global activities that are related to students' everyday life. To implement a competency-based approach, certain principles must be respected. According to Lasnier (2000), this approach is characterized by: comprehensiveness, construction, application, significance and transfer. According to Carette (2008), a student will be competent if he is able to show his ability in facing new life situations. There is no methodology for the development of competency-based programs. This approach does not refer to a particular teaching method. Learning is seen as a personal process with a cognitive, emotional and social character. As a result, several pedagogical strategies and techniques can be used to support learning through using the competency-based approach (Bates, 2015). The competency-based approach requires teachers to make students able to mobilize their learning, while this cognitive activity of mobilization remains immeasurable. Learning to mobilize becomes the central objective in a competency-based approach and raises a major question: how to get students to use what they have actually learned in new circumstances? Without this learning, the concept of competence becomes really dangerous and might lead to further discrimination between students.

Problem Solving Approach

A problem can be defined as a situation in which the organism has a purpose but does not know the means of achieving it. It is made up of data, goals and obstacles (Dupays, 2011). The problem solving approach was developed in 1969 by Howard Barrow and his colleagues in Canada. This approach is increasingly used in areas where it is impossible for students to master all the knowledge in the field within a limited time frame. Studies have shown that students find learning difficult with the problem solving approach. In this latter, students work in groups facing a problem and try to access new information that could lead to the resolution of this problem (Robardet, 1990, 1995, 2001). Despite this, Van Barneveld (2009) found that problem-based learning is effective in developing skills and improving students' attitudes toward learning. In this approach, the problem-solving phase is vital. Indeed, pupils, who actively participate in the construction of various problems in the classroom, will be involved in solving these problems (Boilevin, 2005). Also, the role of the teacher in this approach is essential; it facilitates and guides the learning process.

Historical Investigation Approach

The marriage between the historical approach and the investigative approach gave birth to the "Historical-Investigative" approach. In this section, we briefly discuss the literature of the historical approach, the investigative approach and the Historical Investigation approach. Learning theories and pedagogical approaches do not exclude integrating the historical dimension of science into the learning process. However, school curricula in the physicsdo not provide enough information on the history of the concepts studied. To approach the sciences from a historical point of view gives them a more anchored sense and make the so called "hard sciences" more attractive and more human. In this respect, Bacon announces: the knowledge which would be given as a thread to be extracted again, it would be necessary to transmit it and to make it understood if possible in the very way in which it was discovered (Bacon, 1991). Going back in history brings together the past and the present, exposing the class to knowledge and establishing a relationship of equality between the teacher and the student. Didactics perceive the strong relationship between the historical approach and the epistemological obstacles of Bachelard. This relationship helps identify barriers associated with learning and knowledge to be taught in the school context (Johsua & Dupin, 1993). A well-prepared question that revolves around the proximal area of student development, and which causes a debate in the classroom can identify the barriers of these students. From this debate scheduled, the teacher designs a learning pathway which leads the class to the construction of new knowledge (Guedj, 2005).

DISCUSSION

In the learning process, the educational quality of the investigation is valued by several researches (Chekour, Laafou, & Janati-Idrissi, 2017a; Grangeat, 2013; Tinas, 2013) . Thus, the added value of experiments in the learning of science is an indisputable fact, but that of virtual simulation is criticized by several researchers (De Jong, Linn, & Zacharia, 2013). However, laboratory experiments and virtual simulations can achieve similar goals, such as developing teamwork skills, increasing students' interest in science, increasing conceptual understanding and developing investigative skills (Chekour, Laafou, & Janati-Idrissi, 2017b; Winsberg, 2003). Smetana and Bell (2012) have examined sixty-one studies on the effectiveness of the simulation of learning the physical sciences. The results of this head study show that the simulations are more effective than traditional methods for learning the physical sciences. Other studies confirm that the combination of computer simulation and traditional education may be the most effective strategy for teaching science subjects (Z. Zacharia, 2003; Z. C. Zacharia, 2005; Z. C. Zacharia, Olympiou, & Papaevripidou, 2008). According to these studies, this strategy allows learners to access laboratory materials and take advantage of the various benefits of simulation. The historical approach can be used in the presence of simulation software. Indeed, with a simulation software, students can easily evaluate their own assumptions by changing the settings of the phenomena studied without the need of any hardware implementation. In addition, the integration of simulation in the teaching of physics in the presence of H approach provides an opportunity for learners to identify problems to solve, virtually perform the experiments to validate or reject their assumptions, analyze and discuss the results with their peers. With this techno educational tool, teachers of the physicscan give more and more freedom to their pupils especially at the level of proposition of virtual experiments to validate their hypotheses. Of course, this is not evident for the experimental activities of the laboratory. Indeed, some errors of the learners at the level of manipulation of the apparatus of the laboratory can pose a serious danger for their peers.

CONCLUSION

It can be concluded that multiplicity of different paradigms shows that learning is not a process easily modelable. However, the act of learning is a common activity. Each paradigm brings relevant considerations to learning, but can not unilaterally impose itself on the didactics of teaching a discipline, in particular to the didactics of the physics(Tinas, 2013). The historical investigation approach seems to be consistent with the needs of students and the experimental nature of the physical sciences. In addition, the HI approach may include, but is not limited to, the goal-based approach, the competency-based approach, the project-based approach and the problem-solving approach. Hence, the richness of this approach. Indeed, the problem situation that aims at the attainment of an educational objective is among the key moments of the HI approach. Thus, teachers, who adopt this approach, can propose projects that aim at the realization of certain simulation (of some phenomena) in order to encourage autonomy in their students. Moreover, the HI approach allows, in the presence of simulation, the development of investigative skills, for example, observation of phenomena, formulation of hypotheses and interpretation of results (Droui & El Hajjami, 2014). However, this strategy needs continuous trainings in educational science and the integration of simulation for physics teachers.

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