

Introducing Educational Games in the Teaching of Physics in Moroccan Secondary Schools

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Abstract: A large number of education systems adopted the competency-based approach at the heart of curricula. Morocco as all developing countries understood the importance of this pedagogical approach. Accordingly, the Ministry of Education and professional training adopted it since 2000. In this approach, Teachers support and guide learners in their learning process. Integration of information and communication technologies (ICT) in primary and secondary education greatly facilitates this work. Among the forms of ICT integration, we find the use of educational software in Moroccan secondary schools. We did study concerning the usage of this tool in the education of physics, which revealed the lack of the level related to certain key points in the competency-based approach, namely the learner's engagement to learning and the mobilization of knowledge in the situations encountered. The use of educational games appeared as a remedy for these gaps. In this article, we will show the positive contribution of this choice through experimental studies conducted by several researchers as well as the coherence of the use of this means of learning in the context of competency-based approach. Finally, we are conducting a survey on the place of playing in the universe of the learner and the integration of educational games.

Keywords: educational software, physics, the competency-based approach; educational games, learning.

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I. Introduction

The National Charter of Education and Training (MEN, 2002) in its levers 10 and 11 has essentially insisted on the promotion of the pedagogical innovation, the development of scientific research and the integration of ICT [1]. In the same frame, the Higher Council of Education, Training and Scientific Research (CSEFRS) has just published its "Strategic Vision of 2015-2030 reform for a new vision in education and training" which aims at its twelfth project to strengthen the integration of educational technology to improve the quality of learning, the integration of numerical support and interactive tools in teaching and learning activities, research and innovation [2]. The use of educational software in the curriculum of physics education is also part of these guidelines.

In terms of pedagogical approaches, the Moroccan education system adopted the Competency-Based Approach in order to refocus on the teaching of the capacities of learners. This approach allows the building of competences and knowledge broader, relevant, sustainable and mobilized in situations/problems encountered; in addition, the integration of ICT in the teaching-learning process allows developing the bases of technical and technological competences of communication

However, if we look at the increased development of technological means and the pedagogical and numerical tools used in the education of physical sciences in Moroccan secondary education. We observe a significant gap. In simple terms, it is enough to note that the upheaval of the learner's world is caused by the arrival of Smart phones, which leads us to interrogate the question about the learner's motivation for the use of educational software in the teaching of physics.

According to the results of our first questionnaire, the use of educational software in physics teaching has a negative impact on some key points of Competency-Based Approach. For this reason, the use of educational games seems to us an interesting way which can fill in this lack carried by this software for various reasons, particularly motivation brought for learners as well as the compatibility with the philosophy of Competency-Based Approach, but before addressing these axes, several questions should be asked, especially the place of the playing in the universe of Moroccan learners as well as the opinions of these learners about learning through playing.

In this article, we first discuss the limit use of educational software in the context of the Competency-Based Approach; next, we will shed light on the positive contribution of the use of educational games for the

teaching of the physics within the framework of Competency-Based Approach based on the experiences had already done by several teachers and researchers. The last part will be devoted to the place of the educational games on the eyes of Moroccan learners and their opinions related to the integration of these pedagogical tools. The findings are encouraging because the activity of playing is not only essential and natural for the majority of the learners but also the attitudes of the learners were globally positive about the integration of educational games.

II. What is the relationship between educational games and the Competency-Based Approach?

2.1 Development Of Competencies

With the Competency-Based Approach, the objectives of teaching are no more the content to be transferred rather than the capacity of action to be achieved by the learner. In other words, J. Piaget [3] pointed out that it is by acting that one learns. The work of the psychologist J. Piaget highlighted the importance of playing for the development of many competencies: kinésiques, symbolization, normative, social, and communicational. Other authors have noted the interest of playing for the development of the imagination P. Harris [4] and the creative thinking competency F. Frossard [5].

Educational games regroup all games that propose the player-learners an artificial environment in which they are integrated a structure, contents, rules and pedagogical objectives. It is a type of serious game [6] this latter is an approach based on learning through experience [7]. Accordingly, it allows either developing competencies or acquiring the ability to act [8], in particular stimulating game can engage the participant to measure his level by himself in comparison with others in pursuit of a goal for the development of cognitive, psychomotor, creative and relational skills [8]

Playing, as a child's work, Kergomard [9], allows the student to develop procedural knowledge, to execute complex tasks and to develop competencies [9] All in the context of a conducive situation to learner's expectations. Consequently, educational games involve four types of knowledge (factual, conceptual, procedural, and metacognitive) and allow the acquisition of competencies.

The use of educational video games for Frete can either favor the acquisition of basic competencies or the ability to equip users effectively to act in the world [8]. The first competency implicates that the learner has mastery of the contents, languages, structures and procedures as well as the ability to develop constructive attitudes towards him and others [8]. The second competency needs the ability to communicate and make decisions in a problem-solving context or in the realization of a project [8].

In conclusion, the authors almost mention that playing is an activity that plays a major part in the development of several competencies for the individual, which is compatible with the objectives that are covered by the adoption of the Competency-Based Approach in the classroom.

2.2 The mobilization of knowledge

In the use of the competency-based approach, the term competency has multiple definitions, which all insist on the mobilization of resources dealing with new situations or solve a problem. In this regard, Abdrahim Harouchi, defines a competency as the knowledge to act or the capacity to mobilize this knowledge: know-how, soft skills, and other resources in order to face a new situation [10]. In other terms, according to Sylvie Vant Lint, to be competent, it is getting to mobilize. That is to say, selecting, combining and implementing one or more mental activities on one or more contents that allow solving a problem [11].

In most textbooks, the concept of "activity" in class covers what is required from the students to link to the objectives of learning. The question that arises: can the means of teaching allow the learner to mobilize his or her knowledge? Nicole Delvolve points out that the activities are determined by objectives which allow the student to construct mental tools to learn. The learner needs his tools to advance [12]; building on this latter and also playing as a means that is part of the universe of the learner. We can say that the exploitation of this tool favors the mobilization of its knowledge.

According, to Sylvie Van Lint the use of educational games can be a strong tool in the mobilization of mental activity, especially since classical or traditional teaching methods had been unable to capture interest and provoke enthusiasm or arouse curiosity in the learner. In fact, the learner who plays video games of puzzle type will mobilize all his knowledge to find the right answer. Moreover, in the case of social game, not only does the learner appeal to his knowledge but to his know-how as well. Consequently, playing requires the mobilization of competencies and the development of personal strategies respecting the rules and not to apply procedures learned as in the case of educational software.

2.3 The Learning Situation

Before talking about the learning situation carried by the use of educational games, we focus on the difference between learning and competency. In her writings, Sylvie Van Lint explains that during learning, the learner will be invited to confront different paths of resolution different from one another, and at this time the

task of the teacher appears crucial because he should seek, explore and show to the learner different strategies that are needed to solve his problem. Contrary to competency, the learner has to find the mental activity that leads to the answer, whatever the way is taken and no matter the mental activity used. In other words, as soon as the learner has an idea about all the strategies which were put by the teacher at his disposal, he will build his own strategy that appears relevant and effective to solve the problem in a new situation.

In the competency-based approach, it is not only enough for learners to have knowledge and procedures, but they also should be able to mobilize them judiciously in new situations. It is at this stage that the educational games can be used as the new situations of learning. In this case, J. Château asserts that “the playing is a real situation of non-institutional learning that has a place in school activity.” This quotation consolidates that the learner plays first, then understands and generalizes in order to apply these acquisitions in a new situation. [13]

Competency is built in a situation. It would be interesting that the situation should take into account the expectations of the learners for more engagement of their parts. Ludification of learning situations allows creating a “loop of learning” for keeping the learner attentive and valuating his or her actions and progress.



Figure 1: Loop of engagement

The use of educational games leads to a 'loop of engagement' Fig 1 which enhances feedback, promotes peer interaction and allows differentiation according to learners' needs. K.Elouardani [14].

III. The use of educational games in the teaching of physics.

With the objective of reinforcing the engagement and motivation of the learner, educational games, especially video type start taking an interesting part in the teaching of physics. The thing that had been proved in many studies which emphasized the positive contribution of educational games. In this sense, in our area, we exploited several scientific pieces of research that showed the interest of this educational tool. Furthermore, using this latter, we registered several positive observations:

- Contribution on attitudes towards the subject:

A favorable attitude towards a subject plays a major part in the success of the learner in this subject. It is a positive relation which was proved by numerous pieces of research in the field of education. The overall attitude of learners composes of factors of interest, importance and difficulty. In this context, Mr Young, who teaches physics for 16 years in a school in Quebec, he turned to using video games in order to make learners in his class more attentive to their learning, He noticed that they began to work (play) like madmen with high motivation rate and an important engagement. Physics for some learners is a chore, whereas the learners of the Quebec teacher it is a game. This experience proved that the change of the attitude towards the subject can happen to the learner through playing. Similarly, Cockshut states that online video games seems a good way of giving learners the chance to link their love of playing to the love of learning and this cannot do harm to pedagogical point of view[15].

- Contribution to physical concepts

Students often find the learning of scientific content like physics unimportant because they cannot connect new knowledge to their daily lives. This lack of connection often leads to the absence of interest, motivation and eventually to learning failure. Besides, misunderstanding of concepts can be overcome by the use of educational games. The game allows learners to assimilate new concepts more intuitively in addition to allowing the previous recorded information and organize it in a way to facilitate understanding [16]

A study led by a group of researcher at the University of Michigan showed that there is a possible way (educational games) to make learning about physics relevant to students. In this study, learners were able to learn by playing the game 'Physicus'. The outcome of this experiment indicated that the learners who played assimilated easily physical concepts in comparison with those who did not [17].

Always in the same frame of idea, there is a prototype of a physics-based game (Junkyard Physics) was developed to teach the basic principles of forces. The resulting prototype was tested on learners to determine if the game improved their levels of understanding for physical laws. The findings show that playing is a good way to engage learners with physics. It is a valuable teaching tool, which deserves more research and development [18]. Another study by Pittman highlights the positive contribution of educational games of the

video type for the understanding of physical concepts. They lead to an improvement of the level and the results of the learners; Pittman reinforces that the educational games should have their places in the school curriculum of physics. [19].

- Educational games used as a simulation.

Sometimes to transmit physical concepts through educational games is not obvious, especially when a teacher is in front of educational games that do not meet his expectations to ensure learning. As a result, the use of the game in a pedagogical context is limited in giving examples. It is considered a limited simulation. To put it differently, when one or more players are part of the simulation, they interact with the components of the simulation and if the notion of winner and loser is present, we can talk about the simulation game. Likewise, if the conflict appears in the simulation as an essential attribute and not as content, we deal with a game simulation [20]. For example, it is the same as a game called Angry Birds game based on the puzzle resolution where the player should throw an object (a bird) to reach another target object. The interest manifests in the simulation of the physical model. This aspect of simulation pushes the player to experiment and determine the best possible trajectory to reach the target [21]. It is evident in the light of this above work that educational games is an effective teaching tool for improving teaching methods in physics. It can be used in different levels and according to the needs of the teacher either to change the attitudes of learners, to transmit concepts, or to simulate physical phenomena.

IV. The Problematic

The study that we conducted concerning the teaching of physics using educational software showed that it consolidates certain points related to the competency-based approach, namely the interaction between the peers and their motivation. On the other hand, this tool has limitations, such as learner engagement, retention of information and the mobilization of knowledge in problem situations. Problems can be summarized as follows: how to fill in the gaps of the use of that software in the teaching of physics for more effective teaching of this subject taking into account the pedagogy based on the competency-based approach? The response that we proposed for solving this problem is the educational game, but before considering its integration as a pedagogical tool in teaching physics at the secondary level in Morocco, it is important to have an idea about the conceptions of learners for this type of games. Therefore, two questionnaires were developed to determine the learners 'point of view regarding the playing and its integration into their learning processes.

V. Methodology

This is an exploratory study that focuses on three main objectives:

- Identify and discuss the point of view of the learners about the use of educational software and its possible impact on their learning.
- Identify the attitudes of the learners about the concept of playing and discuss the contribution that can bring this activity to them.
- Identify the point of view of the learners about the integration of educational games in their learning.
- ✓ Target population
The population targeted by our study is made up of 300 learners in secondary education in physics of different levels.
- ✓ Tool of data collection
The survey was fulfilled through three anonymous questionnaires:
 - The first questionnaire collects the learners 'points of view about the use of educational software as well as the way in which the software influences their learning and whether they are still motivating or not.
 - The second questionnaire addresses the notion of playing for the learner and its place in the activities that he practices. The last part tackles the learner's point of view about learning through playing.
 - The third questionnaire focuses on learners' opinions about the integration of educational games in their learning and the reasons why they favor them.

VI. results

6.1 Educational software

The results of the first questionnaire lead us to talk about the limits of the use of educational software.

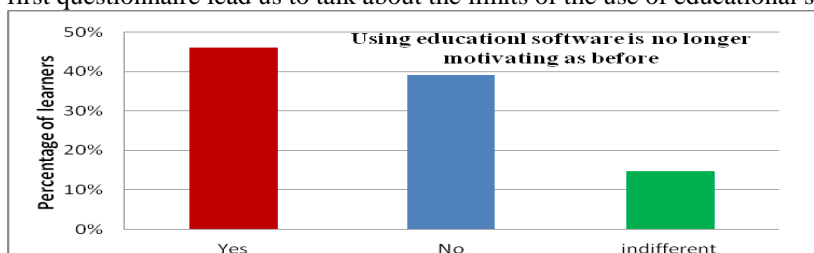


Figure 2

Indeed, 46% of respondents to our questionnaires see that educational software is no longer motivating, and 39% believe the opposite with 15% are indifferent. These numbers are likely to increase over time as almost three-quarters of learners like to have motivating tools than educational software in their learning processes.

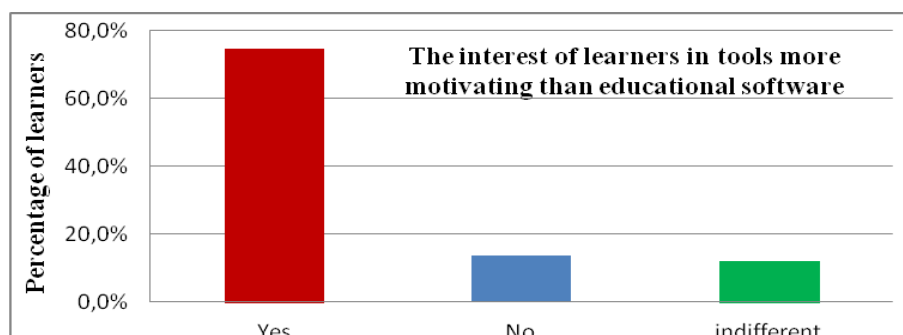


Figure 3

In the same frame we were interested in studying the impact of this educational software on the learner as the latter is the main element in the teaching-learning process in the competency based approach. The questions we have proposed to the learners related to reflection, interaction, retention of information, attention, and access to information. The responses highlighted the lack of certain key points in the competency based approach.

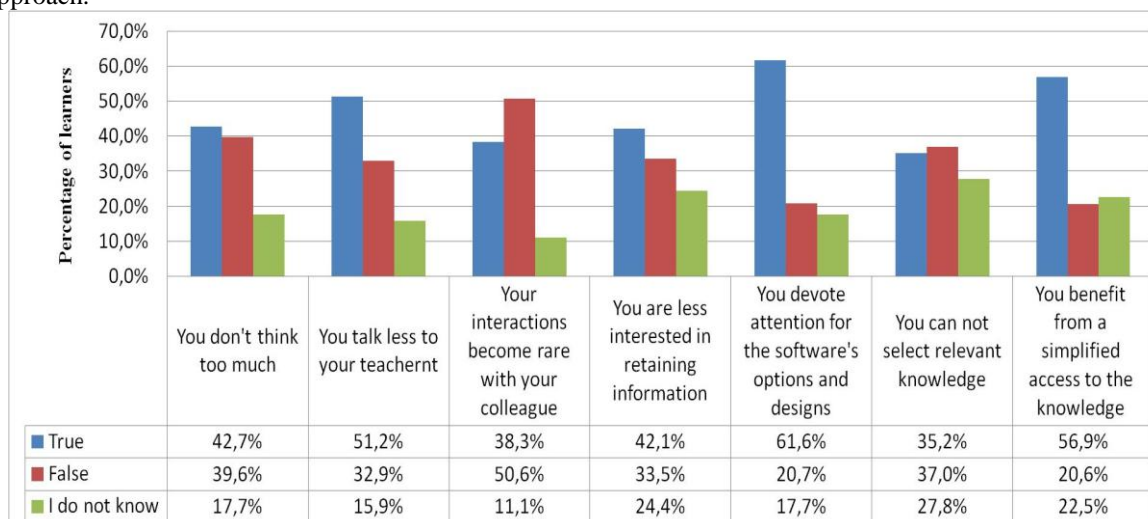


Figure 4

- **Reflection**

The analysis of the situation in the competency-based approach is done through the highest level of the learner's reflection "Competency does not learn, it is the result of the reflexivity of subject faced with a situation in a definite context" Henri Boudreau t[22].

During the use of software they point out the absence of reflection almost (43 % of learners), and almost 18 % could not answer this question while almost 40 % reflected while they use this tool.

- **Interaction**

Interactions with the teacher are very few. 51.2% of learners do not interact with their teachers, 32.9% interact and 15.9% responded by I do not know. This explains the leading role of the teacher in the use of educational software. In addition, the interactions between peers have a significant percentage 50.6% although 38, 3% interact little with their colleagues and the rest had no opinion. The explanation of this as follows: the learner who has a higher level of skill in the handling of the software will be able to provide the necessary instructions to his colleagues, and he shows his understanding whenever the opportunity presents to him. This promotes peer teaching.

- **Retention of information**

Certainly, the retention of information depends not only on the learner's abilities but also on the pedagogical tool used. An important percentage of these learners 41.2% is less interested in retaining information using software, in contrast to 33.5% learners and 24.4% who did not respond. However, in the philosophy of the

competency approach, the learner must make connections with his / her previous knowledge, validate these links with peers, ask questions, do research, take initiatives and use external resources

- Attention

The design and the options offered by the software are true stimulators, they attract the attention of 61,2 % of the learners, and do not attract a 20.7%. These numbers clearly show that there is a division of the attention of the learner during the use of this software tool, which affects the degree of engagement of the learner in the learning situation.

- Choice of appropriate information

To develop competencies means to learn to use appropriate knowledge to solve a problematic situation. Results obtained for this question are categorized in the following way: 37 % of learners have the capacity to choose the appropriate information while a 35,2 % percentage do not succeed in making it; and almost 27,8 % have difficulties in expressing themselves regarding the offered affirmation. This leads us to say that there are still learners who do not know how to sort the information and choose the relevant one.

6.2 Playing in general

Playing is everywhere, but there is a particular conception regarding this activity for each of us. From the results we have obtained, we can say that learners are aware of the importance of the activity of playing.

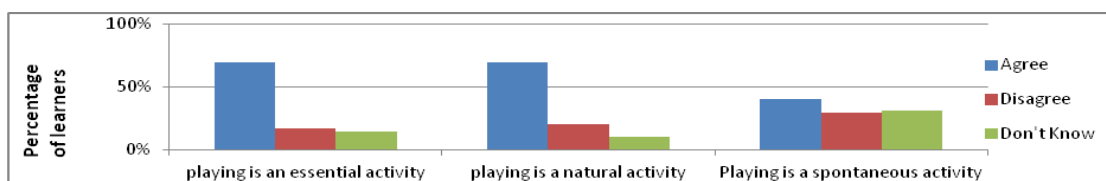


Figure 5

It is essential and natural for the majority 70% and for 40% it is not an activity that can be programmed on a specific date since it can occur spontaneously. In fact, this is the main activity that fills the free time of the majority of learners.

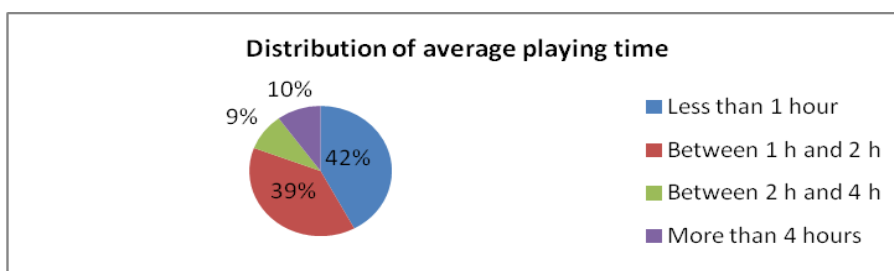


Figure 6

In effect, the Moroccan learner spends almost 1h40min playing each day, which is already a lot. It is almost a third of the time they spend in school. The reasons for playing are numerous (pleasure and entertainment, winning, hobbies ...), so in our case what motivates the Moroccan learner to play?

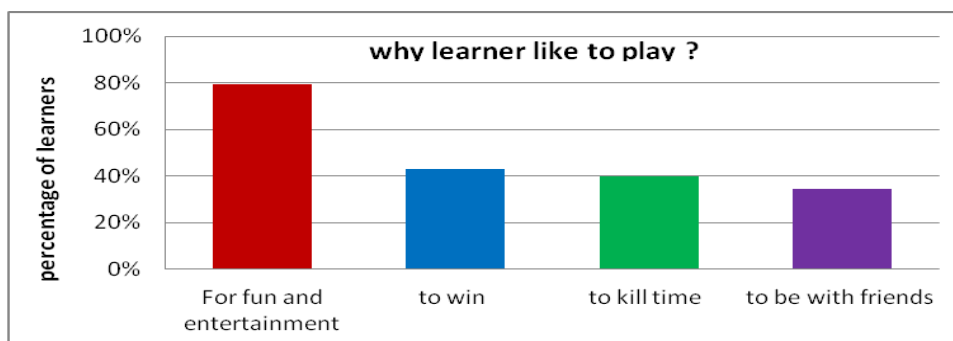


Figure 7

Almost (79%) learners love to play for fun and entertainment but this factor is not the only one. Indeed, (43%) play to win, (40%) to spend time and (35%) to be with friends. Playing is no longer just a hobby but a powerful entertainment tool that generates pleasure to the majority, although sometimes it can be a tool for promoting interactions among peers. Concerning the type of game, the percentage of respondents is not the same for every statement, which gives us an idea about the preference of learners for a certain type of games.

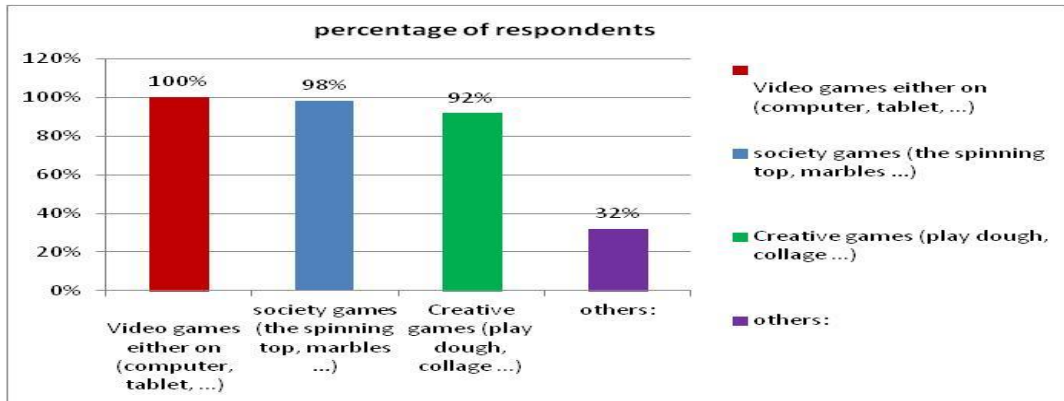


Figure 8

Learners play different types of game, but the dominant one is the video games, with 73% learners often playing this type of game.

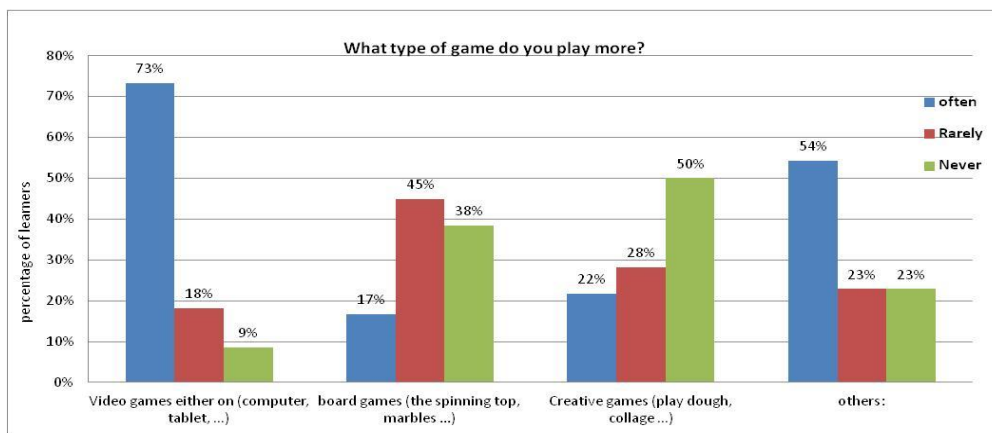


Figure 9

This can be explained by the spreading of the use of ICT tools (computer, tablet ...) and notably by the arrival of the last generation Smartphone, in contrast with group games and creative games, on which learners are not very interested in, judging by the fact that only 17% play society games and 22% play creative games. Playing is representative for more than 65% of learners, it allows to learn a lot, to change ideas, to develop certain skills, moreover most learners (77%) are ready to play with an intention of learning.

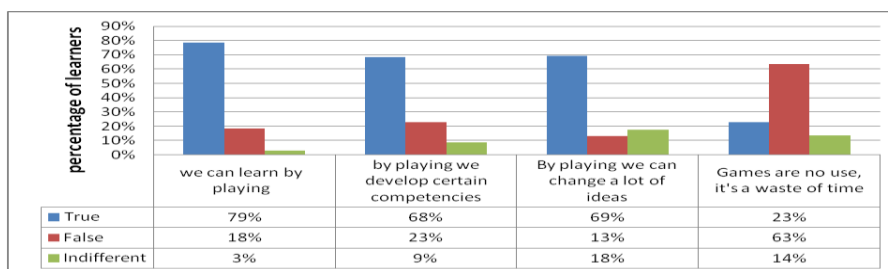


Figure 10

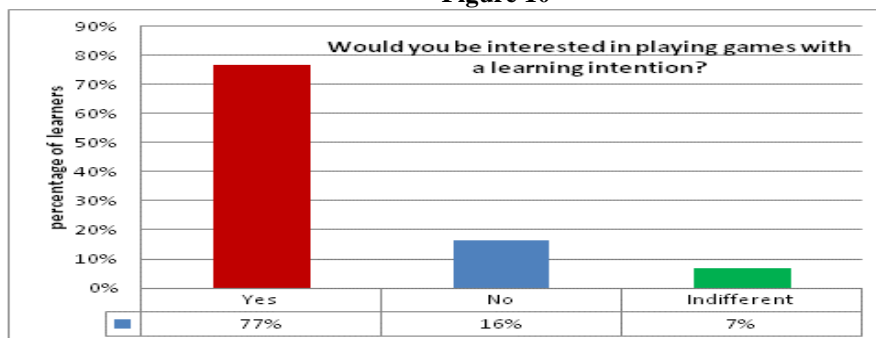


Figure 11

6.3 Educational games

The introduction of educational games in the classroom and especially video games in recent years is due to digital development. It is because of this and because of the positive contribution this tool has in teaching physics that we posed the question of the integration of educational games in the classroom for the secondary level. So, to address this issue we developed a questionnaire to identify the opinions of the learners about the integration of this educational tool in their learning process.

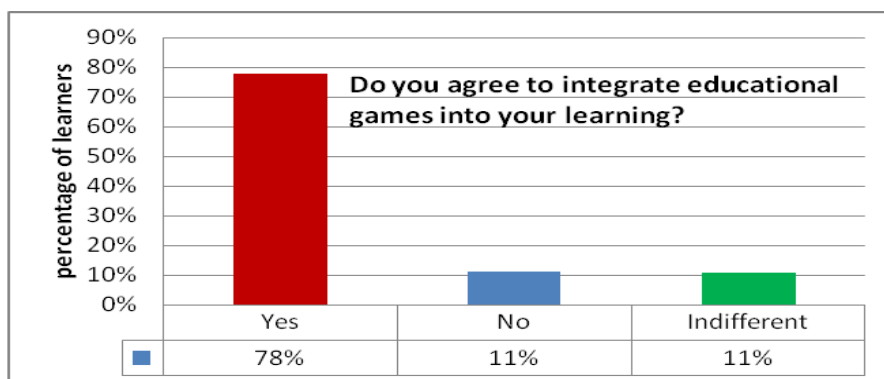


Figure 12

The results show that (78%) of the learners are in favor of the integration of educational games, 11 % are not, and the remaining 11% did not express their opinions. This attitude is generally positive to the integration of games as a tool for teaching in the learning process, is it maybe because it emanates from a sense of an improvement of the learning?

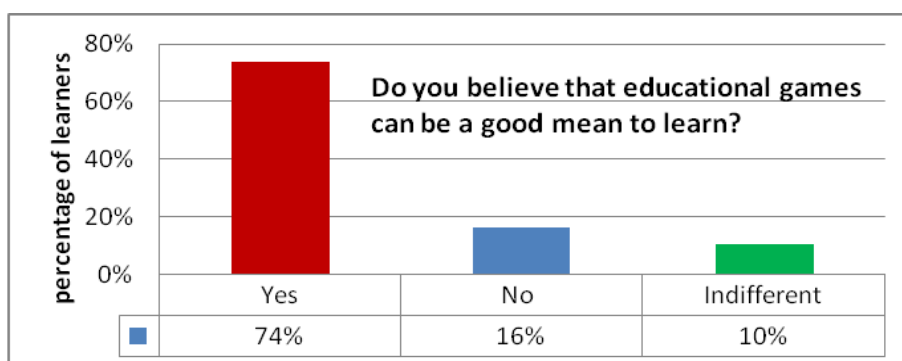


Figure 13

The opinions are both positive and similar when answering this question. Indeed, (74%) of respondents think that educational games can be a good way to learn, (16%) believe the opposite and (10%) do not have an answer. The advantages of integrating educational games are numerous, being the most important one the motivation they generate in the learner, which is an important factor in the learner's commitment to learning, idea that is consistent with the results that we found.

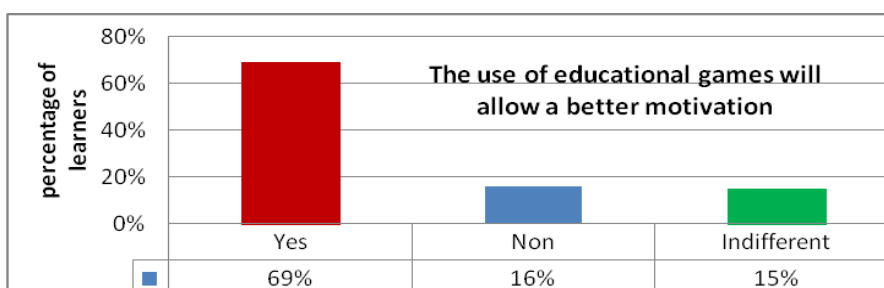


Figure 14

According to the results, 69% of the learners will be motivated by this means of learning, while (16%) think they will not and (15%) learners have not given their opinions. The educational software and educational games are interesting when they meet the expectations of the learner and especially in terms of motivation.

However, if the learner has the possibility to choose between these two tools what will he prefer? This is a question that seems relevant to pose to learners and when we did, half of the learners stated they would like to replace educational software with educational games, while only a (27% did not agree with this idea and another 23% are indifferent to answering this question.

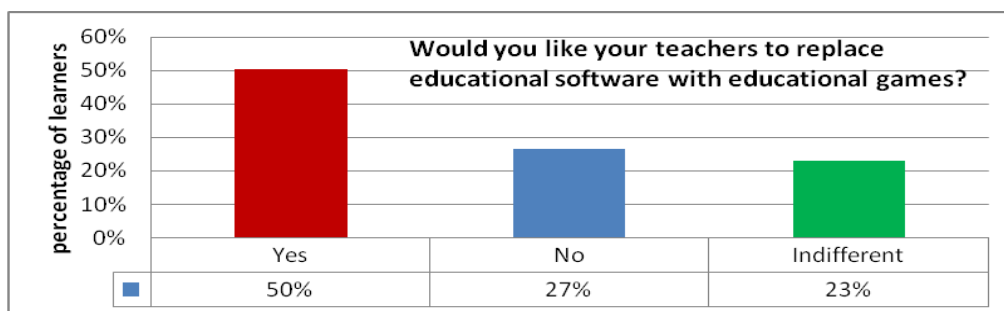


Figure 15

VII. Conclusion

The use of educational games as a learning tool seems to be an interesting approach to analyze in the context of a pedagogy based on competencies, and in view of its relevant contributions to the teaching of physics. In this article, we would like to demonstrate that the integration of this pedagogical tool in the teaching physics at the secondary level will provide a higher motivation and on the other hand, will fill the gap made by the use of educational software in the frame of an approach that insists on the engagement of the learner in his learning and this by: the change of attitudes, the transmission of physical concepts and the simulation of physical phenomena.

In fact, research has revealed that the majority of Moroccan learners have a positive attitude regarding the integration of educational games. Moreover, based on the results obtained, it must be said that it is necessary to exploit the activity of playing with the intention of learning as it occupies an important place in the universe of Moroccan learner.

Some research tracks emerge as a result of this research, it would be interesting to better understand the profile of learners who use the games and then proceed to choosing a game meeting their expectations. As we continue this research we will choose an educational game and test the beginning of it in class. Then we will evaluate the contribution of this pedagogical tool according to different dimensions within the framework of the competency-based approach. This is of such importance that it demands to be worked in full measure in a future article.

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