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# TEACHING OF PHYSICAL SCIENCES IN MOROCCAN COLLEGES: THE OBSTACLES AND DIFFICULTIES ENCOUNTERED

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**Abstract-** Several student failures and difficulties in studying physical sciences present a significant challenge for teachers. Thus, the primary intention of this research is to discover the main causes which contribute to explaining the problems met by Moroccan students of secondary school in physical sciences. To do this, we showed an in-depth study based on a well-administered questionnaire with high school physical science teachers in the Tetouan region in Morocco. The results recorded at the end of this survey allowed us to conclude that these causes are: the heaviness of the physics program, the lack of equipment to carry out the experiments, overcrowded classrooms, etc. possible solutions to overcome these identified problems. For example, the establishment for teachers of techno-pedagogical training on the integration of ICT in teaching practices.

**Keywords:** Moroccan Colleges, Physical Sciences, Experimental Practices, Teaching Practices, Learning Difficulties, ICT.

## 1. INTRODUCTION

Given the impact and the rapid evolution of technology and science in our lives, we are forced in regarding scientific exercise as one of the tasks on which the future of our society's rests [1]. According to, [2], more and more emphasis should be placed on general science education, that is to say on the importance of teaching young people basic knowledge in science not only for training students. scientists, but above all to make science accessible to everyone.

By deeply analyzing the different results of the work carried out by several researchers in a context similar to the present study, we have clearly seen that there is a great failure in science learning all over the world. This failure is reflected mainly in a low level of success, a lack of interest in science and an unscientific attitude towards the phenomena [3]. On closer inspection, this issue of science learning and teaching is not new. Especially since it has been the subject of numerous debates for several decades [4]. Faced with this specific problem, researchers have tried to make various hypotheses in response to the endless questions: what should we teach? What is the purpose of teaching it? At what level and how to teach it? This situation leads us to ask ourselves many questions about the case of science education in Morocco. Note here that this country has just opted for a new education system called the Bachelor system [5]. This system leads to a diploma which is widely used in Anglo-Saxon countries.

If we are to believe the results of the 2015 TIMSS international survey conducted by the IEA (International Association of Evaluation of Educational Achievement) and dedicated to the assessment of student achievement in mathematics and science, Morocco falls squarely behind. peloton, although some improvements in the physical sciences have taken place in the colleges. With these scores, Morocco arrives in a very bad position in the said ranking; away from Asian and European countries. This simply means that the Cherifian kingdom is classified among the countries whose students have a very basic level in science and mathematics. There are also the results of scientific investigations initiated by [6] which have exposed a large part of the loopholes linked to the learning of scientific disciplines such as the physical sciences. To better understand the problem, let us mention, for example, the lack of equipment dedicated to experimental activities. To this end, it should be noted the final report of the study carried out by the researchers [7] which clearly shows the obsolete state in which most of the school laboratories in this country are located. In addition, researchers reported in 2013 the low percentage of ICT use by teachers in their teaching practice [8]. These bitter observations lead us to simultaneously examine the content of the programs and the teaching methods used by the teachers.

## 2. THEORETICAL FRAME

### 2.1. Program and Educational Recommendations

Following official recommendations published by the Ministry of National Education ("MEN", 2015), the teaching of physical sciences at Moroccan college level aims to:

Help the development of a technological and scientific and culture in order to construct first coherent, rational and global representation of the world by highlighting the unity laws which structure it; Strengthen the correlation with other scientific disciplines through the programs by demonstrating both the specificities and physics contributions contributing to the convergence themes;

Be anchored in the daily environment and open to techniques to be motivating and arouse students' curiosity and appetite for science, conditions necessary for the emergence of scientific vocations (technicians, engineers, researchers, teachers, doctors, etc.). (Ministry of National Education in Morocco, "Pedagogical orientations of physical sciences: college cycle", 2015).

According to the researcher [9], the college program is set up over 6 semesters with 2 semesters by level (first year, second and third year). Hourly volume for each semester is 32 hours divided between courses (20 hours or 62.50%) and exercises, evaluations and remedial activities (12 hours or 37.5%). The weekly physical science schedule is 2 hours for all levels, split evenly between lessons (1 hour) and experimental activities (1 hour). Still, according to the Ministry of National Education's, the methodology used in trying to teach physical sciences in college is based on various forms of didactic task as well as different instructional methods and using ICT as a support for teaching / learning of physical sciences.

### 2.2. Importance of Carrying out Experimental Activities in Teaching Physics

Experimentation is regarded as a crucial factor in the teaching and learning of physics, by both curriculum designers and teachers. In many countries of the world, the curriculums use scientific activities mainly for two main objectives: a first objective aims to allow students to understand the modern world as an enlightened citizen and secondly to prepare for the professional world [10].

As for the authors, consider that the goals assigned to experimental activities in teaching are innumerable, namely to motivate students, develop manipulative skills, promote the learning of knowledge, methods, awaken scientific attitudes, learn to work in groups, work autonomously [11]. For his part, Gruson, 2012) believes, in turn, that experimental activities make it possible to go through the concrete so that scientific concepts are very well assimilated by students. Therefore, when the student experiments, he has the opportunity to ask questions and analyze the results he wants to achieve. It should also be noted that there is a great deal of research carried out in different countries which reveals the difficulties experienced by students in making the links between experiences and theories. As proof, in Morocco, in agreement with 68% of teachers only carry out 50% of the experiments programmed in the school manual [12].

This can be explained by the lack of adequate logistics or the deteriorated condition of the laboratories. From these elements we can understand why science education in this country faces several challenges such as poor performance of students in physical sciences (CSE, 2009).

### 2.3. The use of ICT in Learning the Physical Sciences

The teaching of any scientific discipline aims above all at the transmission of specific knowledge. The experimental character of physical science, which must be rigorous, occupies a special place. As such, it must be taught from the observation of experiences which are also conceived as a means of proof, understanding and validation of laws [13].

That said, with the emergence of ICT information and communications technologies and their integration into teaching and education, these tools offer us real technological opportunities to improve and achieve greater success. the act of teaching / learning. Therefore, from this point of view, the inclusion of ICT in science education will be an effective alternative to increase student motivation [14]. Moreover, researchers [15] believe that this could simplify the real systems studied. So, they see this integration of ICT coming to help the realization of experiments inaccessible due to the unavailability of equipment for experiments in laboratories [7].

The central question of our research is that of discovering the difficulties and obstacles linked to teaching in the physical sciences (mechanics). For this, we approached secondary school teachers in physical sciences in the Tetouan region.

The main objective of this research is to fulfill the following objectives:

• Discover the different teaching practices used by these secondary school teachers in the Tetouan region to teach physics (mechanics);

• Identify the difficulties encountered by these teachers when teaching mechanics.

To accomplish these missions, we carried out an empirical study based on an anonymous questionnaire.

## 3. METHODS

For this study, our sample is made up of 50 secondary school physics teachers with good experience in physical science education. All part of the provincial delegation of Tetouan. Regarding data collection, we manually distributed an anonymous questionnaire (see appendix 1) to our respondents. The questions contained in this document are closely related to each objective of this research, they are prepared on the basis of the following points:

- Teachers' conception of the content of school programs reserved for their subject;
- The discovery of teaching practices (pedagogical approaches) used to teach physics (mechanics);
- The importance of carrying out experiments in the classroom;
- The use of ICT in learning the physical sciences.

It should be noted that the said questionnaire includes two kinds of questions: closed questions and open questions supplementing the first ones and giving more freedom of answers to the questioned.

In addition, the issuance and resolution of these questionnaires were carried out during the academic year 2020-2021 in a space / time of and three months. For the data collected, they were analyzed and analyzed by Excel and SPSS software.

## 4. RESULTS AND DISCUSSION

### 4.1. Results

First, we looked at the average number of students enrolled in the classes in which the teachers targeted by this study teach. The results in Figure 1 show that the majority of teachers surveyed (52%) teach in classrooms with an average number of students between 25 and 35 per class. Almost all of teachers (82%) have at least one computer connected to the Internet as Figure 2.

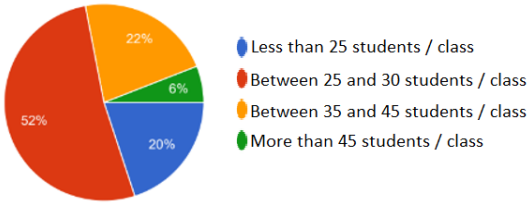


Figure 1. Average number of students in classes

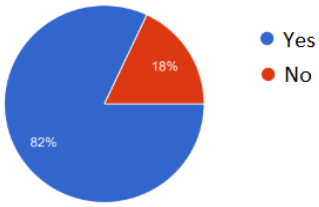


Figure 2. Teachers' point of view on the issue related to owning a computer connected to the Internet

Next, we looked at their degree of computer skills. According to the answers obtained on this question, 46% of the teachers surveyed have a beginner level (research in the web, office automation, etc.) in computer science as shown in Figure 3. We then questioned them about the content of school programs and teaching methods. The results in Figure 4 show that the amount of time allocated to physics education is insufficient, at 44.9% (Figure 4).

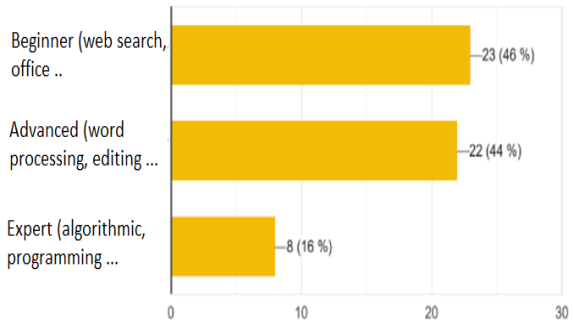


Figure 3. Teachers' perspective on their level of computer skills

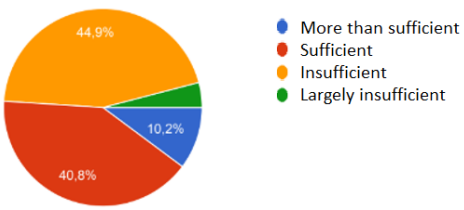


Figure 4. Teachers' point of view on the amount of time reserved for teaching physics

Regarding the pedagogical approaches used by these teachers in the teaching of physics, we can notice that 39.2% of them use the project/problem approach to teach their subject as Figure 5. According to these teachers, 59.6% of students find mechanical concepts complicated as shown in Figure 6.

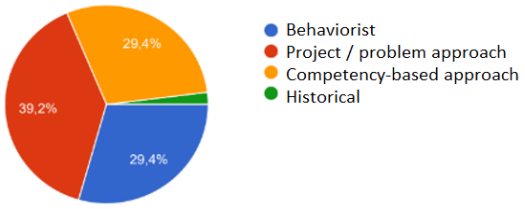


Figure 5. Teachers' perspective on their teaching approaches used in teaching physics

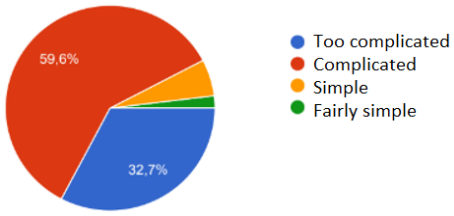


Figure 6. Teachers' point of view on the assimilation of concepts of mechanics by their students

The majority of these questioned teachers (51%) slightly agree with the statement that the structuring of the mechanics course in the physics program helps students build their knowledge, know-how and access to autonomy (Figure 7). The 56% believe that the percentage of completion of the experiments programmed in the physics program corresponds to the range of 10% and 50% of completion as shown in Figure 8.

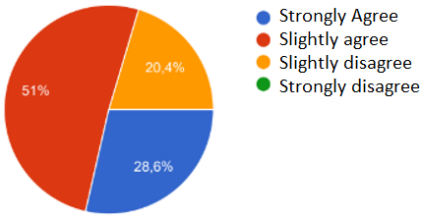


Figure 7. Teachers' point of view on the structuring of the mechanics course in the official curriculum

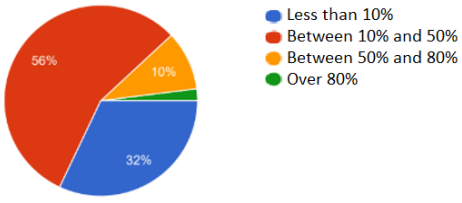


Figure 8. Teachers' point of view on the percentage of completion of the experiments programmed in the physics textbook

As for the question on the most important experiments which must at all costs be carried out within the framework of the learning of mechanics, the teachers think that it is about: the experiments on the centrifugal force, the thermodynamics (measurement of the heat capacity of a calorimeter; measurement of calorimetry

and changes of state.), error calculation, (density of aluminum and steel; measurement of length, mass and time), Hydrodynamics, the experiment to show the principle of inertia, the theorem of kinetic energy, the fundamental law of dynamics.

Then, we asked for the views of teachers on using ICT as a teaching tool of their subject. Results obtained on this question confirm that 63.3% of teachers "strongly agree" with the statement that ICTs are quality teaching tools as Figure 9.

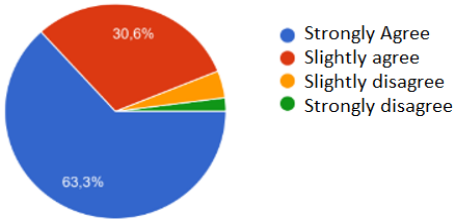


Figure 9. Teachers' perspective on the use of ICT in physical science education

In addition, the 59.2% of these teachers surveyed declared that they had made more use of content presentation software (MS Power Point, Libre Office Impress, Sway, etc.) to teach physics (Figure 10). As for the question of whether ICT make teaching-learning easier, the answers of the teachers collected show that 63.3% of those questioned are "Strongly in agreement" with this statement (Figure 11).

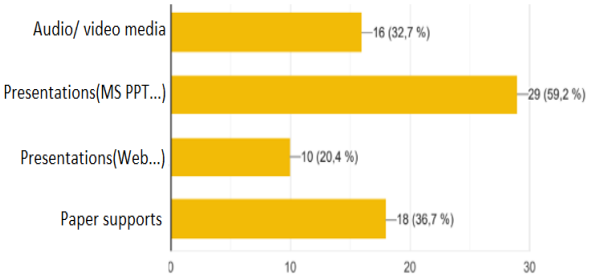


Figure 10. Teachers' perspective on the ICT issue they are currently using when teaching physics

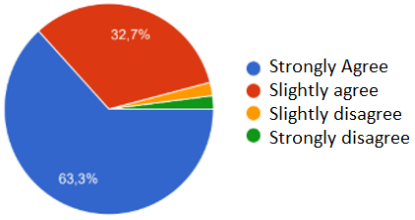


Figure 11. Teachers' views on whether ICT makes teaching-learning easier

We also surveyed teachers about the issue of using simulators to teach physics. The results collected on the said question indicate that 34% of these teachers use it "Rarely" to teach physics (mechanics) as in Figure 12. It should also be noted that 50% of the teachers who participated in this research "Strongly agree" with the statement that simulations can replace certain experiments in physics (mechanics) as in Figure 13.

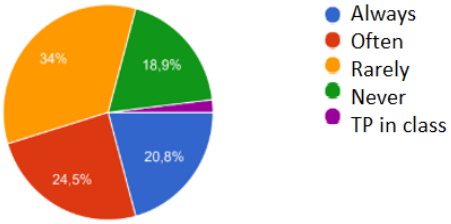


Figure 12. Teachers' point of view on the use of simulators to teach physics (mechanical concepts)

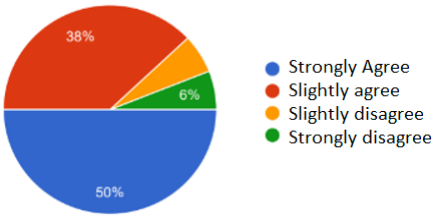


Figure 13. Teachers' point of view on the question of replacing certain experiments in mechanics by the use of simulators in teaching physics

### 4.2. Discussion

Through this study, we tried to discover the difficulties and obstacles encountered by secondary school physical science teachers in teaching their subject in the Tetouan region of Morocco. The results clearly show that the majority of teachers face a somewhat large average number of students in their classes. This reality is not at all conducive to learning physics because the size of the class has an impact on the organization of experimental activities, given the lack and unavailability of dedicated equipment [9].

We noticed through the answers of the teachers recorded that most of them (46%) of them have a level of computer skills called "beginner". These results have just justified the cautious attitude of Moroccan teachers at the secondary level vis-a-vis calls for the integration of ICT in classroom practices [16]. Our research still shows that the hourly volume allocated to the teaching of physics at the level of the Moroccan secondary cycle is insufficient. This is explained by the heaviness of the program of this subject as affirmed by the teachers of physical sciences at the secondary level of the provincial delegation of the provincial delegation of Settat in Morocco [17].

It should be noted that a good part of the teachers in our survey revealed that they had increasingly resorted to the project/problem approach to teaching physics. We note that these results coincide and find their justification in what the author tells us [18] about the teaching of physics in France:

French pedagogical literature has frequently used the expressions situation-problem or open problem in the field of physics teaching for several years. To justify this use, the didactic interest of the problems is often put forward, the relationship maintained between problem and learning of physics appearing essential. Let's also quote who saw things the same way as our surveys saying that "The pedagogical approach based on problem-based learning (PBL) has proven its success in many different disciplines, especially in physics" [19].

Also, more than the majority of teachers interviewed confirmed that students find the concepts of physics (mechanics) complicated. The opinions of these teachers on this specific point are in line with the results presented by a large number of studies which have highlighted the many obstacles that students encounter in understanding concepts or notions that are nevertheless considered elementary [20]. In fact, these difficulties encountered by students in learning concepts arise from various factors. The nature of scientific vocabulary learning science at school requires that the student memorize a large number of concepts and principles whose meanings are not usually obvious to him. The very nature of scientific vocabulary places particular demands on memory [3]. On the other hand, he finds that its esoteric character constitutes a major and persistent obstacle to the understanding of students [21].

More than half of the teachers questioned in the context of this research believe that the structuring of the mechanics course in the physics program helps students to build their knowledge, know-how and gain autonomy. Given the importance of the textbook in the teaching-learning process, the improvement of this school tool will only have a positive influence on the appropriation of concepts among Moroccan middle school students. As proof, the researchers argue that textbooks are both an important resource for teachers in the preparation of their lessons and a real point of support for students who can use them to get more details, complete the concepts studied in class, why not solve the exercises at the end of the chapter [22, 23].

With regard to the percentage of the realization of the experiments programmed in the program of physics, the results of our research clearly show that the rate in question is between 10% and 50%. These results could be understood insofar as all the experimental activities are carried out in the form of experiments during the course session in order to explain the subject. And this lack of experimental activities, as so well indicates, is at the origin of false representations among learners. Note also that these results are consistent with those published by Coquide (2000) [24] [7].

Teachers, for their part, believe that the important experiments to be carried out in the context of learning physics at secondary school level are: experiments on centrifugal force, thermodynamics (measurement of the heat capacity of a calorimeter; measurement calorimetry and changes of state), error calculation, (density of aluminum and steel; measurement of length, mass and time), Hydrodynamics, experiment for show the principle of inertia, the theorem of kinetic energy, the fundamental law of dynamics. Without forgetting related experiments on mechanical oscillators. In view of all these answers, we believe that the choices of these course experiences could be motivated by realities such as the lack of equipment dedicated to experimental activities. But also, as [6] asserts, "in the purely Moroccan context, experiments are reduced to classroom experiences where it is simply the teacher who manipulates and exploits the results. In this context, students rarely have the opportunity to manipulate.

Regarding the use of ICT in the teaching of their subject, teachers are almost unanimous in saying that it is really a quality teaching tool. These results agree with what Altet, M. (2001) asserts on the importance of the use of ICT in modern education: "ICT are considered today as essential tools of the learning process. The activities implemented can no longer be repeated monotonously day after day and therefore the teacher is required to innovate regularly". We can still use the same logic to cite Tardif (1996) who believes that:

The integration of new information and communication technologies in the classroom is a major undertaking that leaders, whether local, regional or provincial, must not take lightly. I am sure that these technologies will affect school practices, both in terms of teaching and evaluation, and in this sense, as education professionals, we must be proactive. We must anticipate the changes to come and experiment with various avenues.

On the question related to the ICT regularly used by teachers in their teaching of physics, the analysis of the answers obtained on this question shows us that the majority of respondents (59.2%) used only the software presentations (MS Power Point, Libre Office Impress, Sway). These results are all the more logical since the majority of our respondents have a level of computer skills qualified as "Beginner". Their degree of competence in question constitutes "the stumbling block, the disqualifying obstacle to the use of technologies in teaching and learning" [25]. This proves sufficiently that these teachers do not benefit from continuous training in order to update their level of competence on active pedagogies and on the use of ICT in teaching. And yet, this is what the national education and training charter (MEN, 2002) and the Higher Council for Education, Training and Scientific Research (CSEFRS) recommend in its strategic vision of the reform [of the education system] 2015-2030, precisely in its chapter number 2, 14 pillars, to the strengthening of the qualification of teachers to achieve the objective of innovation, and therefore, to improve the quality of teaching-learning. We say that this problem will only be solved once the competent authorities apply the resolutions adopted by the authorities mentioned above. Because "the successful integration of ICT in schools depends largely on the leadership and technological skills of school leaders" (Sharrat, 1999).

Beyond the integration or use of ICT in the teaching of their subject, the 63.3% of respondents strongly confirm that ICT makes teaching-learning easier. These results reinforce one of the strong conclusions drawn by Hassouny (2014) during his doctoral thesis work on ICT. Here is the content:

As for the impact of ICTE, the research results seem to be very positive. Indeed, starting from the synthesis of a number of works in literature, we can say that ICTE seems to improve:

- Knowledge;
- Academic performance;
- Motivation;

- Continuity between learning time in and out of the hunt;
- The variety of teaching and learning methods;
- The increase in the ability of problem solving and use of metacognitive strategies of students;

In this context, it becomes more than appropriate to strengthen the rate of use of ICT in Moroccan secondary schools and why not to make them transversal technological training practices. That is, to use it not only as a general tool for teaching physics but also for teaching all other subjects.

We note that on the question of whether they use simulators to teach mechanics, opinions are divided on this question and the small majority of these respondents (34%) only use it "rarely". These results cross those disclosed by the researchers [12]. In fact, the latter discovered that the competence of physical science teachers in Morocco in simulation software is less than 1%. To circumvent this obstacle, here is what the respondents proposed: These teachers, for the most part, have expressed the desire to pursue training relating to the pedagogical integration of ICT in educational practice so that they can use computer simulators on a daily basis in their school activities. [26].

Responses to the question of whether simulations can replace certain mechanical experiments show that the majority of teachers who participated in this survey "strongly agree" with such an assertion. This attitude of the teachers surveyed is justified insofar as computer simulation can completely replace the experiments not carried out due to the lack or absence of scientific equipment [27-30].

## 5. CONCLUSION

The research we conducted has allowed us to show that the number of students in the classrooms in Moroccan colleges is not really advantageous for the moment for the teaching-learning of physics. The fact that the majority of teachers have at least one computer connected to the internet is a good thing for them to update and energize their teaching to adapt them to their students.

Physical science teachers have a so-called "beginner" level of computer skills. To overcome this case, specific techno-pedagogical training on the integration of ICT in the teaching practices of these teachers is a real palliative solution. These training courses, in their design, should allow them to have at least an acceptable level on ICT and the handling of computer simulators because simulations can replace the experiments not carried out due to the lack or absence of equipment. scientist. It should be noted that these trainings must be the subject of a real follow-up and a very good evaluation.

According to the opinions expressed by the teachers who participated in this research, it seems to us, based on their responses, that the key results of our research are:
The number of hours allocated to the teaching of physics at the level of the Moroccan secondary cycle is insufficient; The project/problem approach is the pedagogical approach most used by teachers to teach physics; Students have difficulty understanding the concepts of physics (mechanics) on their own; The structuring of the mechanics course in the physics program helps students build their knowledge, know-how and gain autonomy;

The percentage of the realization of the experiments programmed in the physics program carried out by the teacher during the hours of the lessons is between 10% and 50%; Experiments on centrifugal force, thermodynamics (measurement of the heat capacity of a calorimeter; measurement of calorimetry and changes of state.), error calculation, (density of aluminum and steel; measurement of length, mass and time), Hydrodynamics, the experiment to show the principle of inertia, the theorem of kinetic energy, the fundamental law of dynamics. Without forgetting the related experiments on mechanical oscillators which would be the most important experiments to carry out in the context of learning physics at the secondary level; ICT would really be a quality educational tool to be integrated into the teaching of physics; The ICTs regularly used in their teaching of physics would be content presentation software (MS Power Point, Libre Office Impress, Sway, etc.); Simulators are rarely used to teach mechanics in Moroccan colleges.

After this exploratory study, we make our work available to other researchers for them to deepen in future research. We plan to conduct another research, this time more detailed on the use of ICT in the teaching of physical sciences in Moroccan colleges. This time, it will be a question of appreciating the impact of ICT in understanding or the assimilation of the conceptions of mechanics among the pupils.

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