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EVALUATION OF EFFECT OF A TEACHING-LEARNING DEVICE BASED ON TUTORING AND INFORMATION AND COMMUNICATION TECHNOLOGIES ON COMMON CORE

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Abstract- The objective of this study is the design, experimentation and evaluation of an Information and Communication Technologies (ICT) based device with a view to revitalizing the teaching-learning of physics and optimizing the conditions of use of differentiated pedagogy and motivating learners to become more involved in the construction of their learning. This device is experienced in person and is based on experimental activities and the use of digital resources and tools (simulations, PowerPoint presentations, quizzes, videos, etc.). To do this, a computerized network has been created to train groups of students, using the Net Support school software as a pedagogical support and which offers teachers several features and possibilities of evaluation, supervision, collaborative work and remote control, instant exploitation of the results of quizzes dedicated to diagnostic and formative evaluation whose results are exploited in the implementation of differentiated pedagogy. The experimentation of the device was carried out with 420 learners of the common core. The learners, subjects of the experiment, individually equipped with computer or tablet and headset, were divided into groups of 5 to 6 people whose composition changes according to the results of the quizzes. The evaluation of the device was done by the learners and by the teachers. The results seem interesting and show a positive evolution in the development of learners' achievements and their behaviors compared to those of control groups who did not benefit from the device.

Keywords: ICT-Based Device, Differentiated Pedagogy, Digital Resources and Tools, Physics, Evaluation, Common Core, Net Support School.

1. INTRODUCTION AND PROBLEMATIC

The integration of information and communication technologies (ICTs) into teaching and learning seems to be a strategic choice. It seems that they have become essential in any education system and considered as strategic imperatives to improve the quality of education [1]. In this sense, [2] states that: "Information and communication technologies, their different fields of use and their potential for development are at the heart of the changes, transformations, issues and challenges facing today's world of education", page 78.

For ICT integration to be pedagogically efficient, [3] insists that the systems adopted must be based on more incentive-based and interactive methods and that technologies be supported by new roles for teachers and learners. Indeed, the practices in this context should encourage the learner to invest in the construction of his or her learning by collaborating with his or her peers and favor "learner-learner" and "learner-teacher" interactions. Thus, the teacher would play the role of catalyst, facilitator, tutor and guide and the learner could develop more autonomy and self-esteem. Information and communication tools, as highlighted by [4], are effective as an educational and pedagogical support for learners and it is the same for the teacher in the management of his classroom.

Among the axes of research in didactics of physical sciences we note the study of the mental representations of the learners. These, characterized by its dynamic and developmental evolution and stemming from one's individual and social history continuously interact with the sociocultural and educational environment in a dynamic way [5, 6, 7, 8, 9, 10]. Hence the interest in taking them into account for an efficient and differentiated learning process. But why differentiate? Learners may have different representations and therefore different needs, they do not learn at the same pace, in the same way either, they do not adopt the same behaviors and do not necessarily have the same aspirations and motivations and therefore different goals and heterogeneous profiles. This heterogeneity requires teachers, throughout their career, to adopt compatible teaching methods, adapted to each learner, which makes the task more complex for the teacher, especially in a context of class overload and time constraints.

It is true that differentiated pedagogy is unavoidable [11, 12, 13, 14] in this context, but its adoption requires a shift from a stable and classic organization to one that is continuously rethought and readjusted in an instantaneous and dynamic manner.

However, the integration of ICT based on appropriate tools could support the teacher in the management of his class by allowing a certain flexibility in the organization of the space as well as in the group work on the one hand and promote peer learning as well as the interaction "Learner-Teacher" on the other hand. Indeed, ICT creates a stimulating and dynamic environment since it allows learners to experience success in carrying out varied and diversified activities according to their specificities [15]. In the Moroccan context and according to a study conducted among a sample of learners of the common core what corresponds to the first year of high school, the majority of students report having representations often erroneous on the concepts addressed in physical science and that they are rarely taken into account by teachers and therefore persist [16]. The teachers feel that the working conditions are not conducive to quality teaching-learning and their practices seem to be of the so-called "traditional" type. They state that they do not take into account the individual and intellectual differences of learners and find it difficult to adopt problem solving, the investigative approach and ICT in their practices, even though they are recommended in the official pedagogical guidelines.

Based on these observations and our field experiences, and taking into account the fact that the teacher cannot ensure the achievement of learning objectives for each student, even for a class of 20 learners [17], we have tried, in this study, to experiment a device based on a computer network for the teaching and learning of mechanics and electricity in the core curriculum with a view to creating a climate conducive to learning that favors the taking charge of the learners' representations and the application of differentiated pedagogy in real time, which will benefit all learners, regardless of their initial level or ranking. In order to improve the system and reinforce its positive contributions, we evaluated its effect from the point of view of teachers and learners.

Concerning Information and Communication Technologies (ICT), these can include machines, software and various services. They include, among others, technologies related to the Internet, multimedia broadcast on CD-ROM, robotics and virtual reality [18]. In this study, we adopt the definition of [19] and therefore, technologies are understood as teaching content and also learning environments that promote the construction of learning as well as collaboration and interaction.

2. RESEARCH METHODOLOGY

The work of this research was organized in 3 stages. The first step was the design of the computerized device to deliver core mechanical and electrical courses. The second stage of the research focused on testing the device with groups of learners and evaluating its effect on learning by comparing the test results of the experimental groups with those of the control groups. The third stage of the research focused on testing the device with groups of learners and evaluating its effect on learning by comparing the test results of the experimental groups with those of the control groups. Learners and teachers volunteered and were prepared before the experimentation phase. The study involved 13 core classes with an average of 30 to 32 learners per class.

2.1. The Used Device

In each room and for each session, a computer network was created for 5 or 6 groups of learners. In order to facilitate the management of the room and the class group by the teachers. It was decided to use NetSupport School as a pedagogical support offering various functionalities for evaluation, supervision, collaborative work and remote control. Indeed, NetSupport School allows you to plan, present the content of a lesson and supervise the activity on the students' workstations, which would help maintain the attention and concentration of the students.

The choice of NetSupport School [20] is motivated by the fact that it allows, among other things:

- Share the teacher's screen (paragraph reading, animation, video, quiz...) with all or some students, broadcast the recording of the presentation, including the content (audio, video, file...) to the students' PCs for later viewing.
- Visualize, control, monitor, and supervise the students' screens in real time, from the teacher's PC (start-stop, disconnect-connect, lock the mice and keyboards...of all the machines in the classroom.
- Assess learning with the ability to create an instant survey using predefined or custom responses, get immediate responses from all students and a class summary, publish survey results to all students and dynamically create new groups based on student assessment results.
- Use it for all popular computer and tablet systems, including the mobile version for teaching assistants.

2.2. Experimentation of the Device

In each created classes, the students were divided into 5 to 6 groups. Each group consists of 5 to 6 students equipped with an individual computer or tablet and headphones. These small groups are reorganized as needed according to the criteria of differentiated instruction. Indeed, the teacher instantly visualizes and uses the results of the quizzes designed to diagnose cognitive and behavioral learning difficulties and consequently modify the composition of the groups as needed. Each student has the opportunity to discuss his or her work with another student in the same group in a peer learning setting or with the teacher in a direct, one-on-one setting, and may be asked to present his or her work to the entire class.

2.3. Evaluation of the Effect of the Device

The evaluation of the effect of the device was done first by exploiting the results of the continuous tests of the experimental groups and of the control groups having received the same learning but without the computerized device. then by the learners and by the teachers. Continuous assessments and in-class assignments were used to evaluate the degree of development of the learners' learning and consequently the effect of the system on the evolution of the learners' cognitive level.

The evaluation made by the learners was carried out through a questionnaire made up of 8 items covering, among others, the aspects related to the management of the course, the concentration, the motivation of the learners, the degree of their participation, the development of scientific reasoning as well as the rhythm of learning. We note that only 50% of the sample responded to the questionnaire, namely 210 learners. The evaluation by 70 physical science teachers was carried out by means of a questionnaire developed for this purpose. The questionnaire is composed of 10 items concerning, on the one hand, the effect of the system on the management of the specific needs of each student, the concentration, the motivation of the learners, the management of time, the overcrowding of the class and the use of ICT and, on the other hand, the difficulties of the implementation of the said system.

3. RESULTS AND DISCUSSION

3.1. Experimentation Phase

In this phase, the results of the students were grouped into three categories, according to their academic performance: good students (GS), students with an average level (SAL) and students with a low level (SLL) in order to be able to compare the effect of the device on each category (Figure 1). The percentages given express the difference between the results of the experimental group and those of the control group.

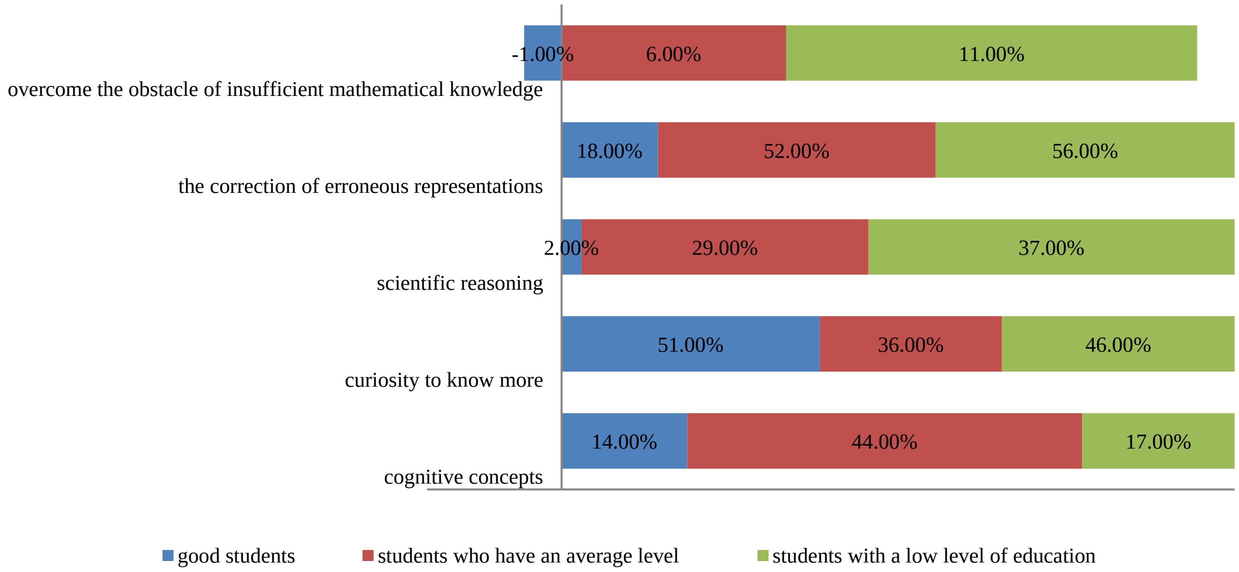

Figure 1. Percentage difference between the effect of the ICT-based device and, control and experimental groups

As shown in Figure 1, the results seem to show that this method is very beneficial for all three categories of learners. However, the difference between the two control and experimental groups is more remarkable for SLL. Indeed, regarding the correction of misrepresentations, the effect of the device is more marked among SLL (56%), followed by SAL (52%) compared to GS (18%). At the level of scientific reasoning there is a difference of 37% for SLL and 29% for SAL and only 2% for GS. On the other hand, in terms of cognitive notions, the most remarkable difference was that of SAL (44%) followed by SLL (17%) and then GS (14%). Curiosity to know more was further evident in GS with a difference of 51%, followed by SLL (46%) and 36% for SAL. We note, however, that the device did not allow for an additional contribution to overcome the difficulties related to the mathematical knowledge to be mobilized in physics. The evaluation of the cognitive learning of students who were initially at a low level seems very encouraging since 92% of the learners obtained better grades.

Indeed, there is a remarkable evolution in the cognitive level of the majority of students. Since 92% go from SLL to a good level while 8% go from low to average level thanks to the device. On the other hand, for the control group, the majority remained weak at the cognitive level, except for a few cases (5%) who were able to move from a weak level to an average level. These results seem to show that this method favors the improvement of the cognitive level of students who started the common core with a very low level. Moreover, we started to use this method just after the second continuous assessment and according to the curve we notice an evolution of the marks of all the students who benefited from the device compared to those of the control groups. These results show the effect of this method not only in terms of efficiency but also in terms of its effect on the students, the majority of whom move from a low level to a good level at the end of the year.

Indeed, the cognitive level of the students evolved rapidly between second Continuous Test (CT2) and CT4, and then each student maintains their achieved level for CT5 and CT6. On the other hand, for the control group there is neither a stability of results nor a well-defined structure of these results, illustrated in Figure 2, which represents the evolution of the marks from one continuous assessment to another, for a sample of students who were initially at a low level and who benefited from the system, and in Figure 3, which concerns the results of students in a control group.

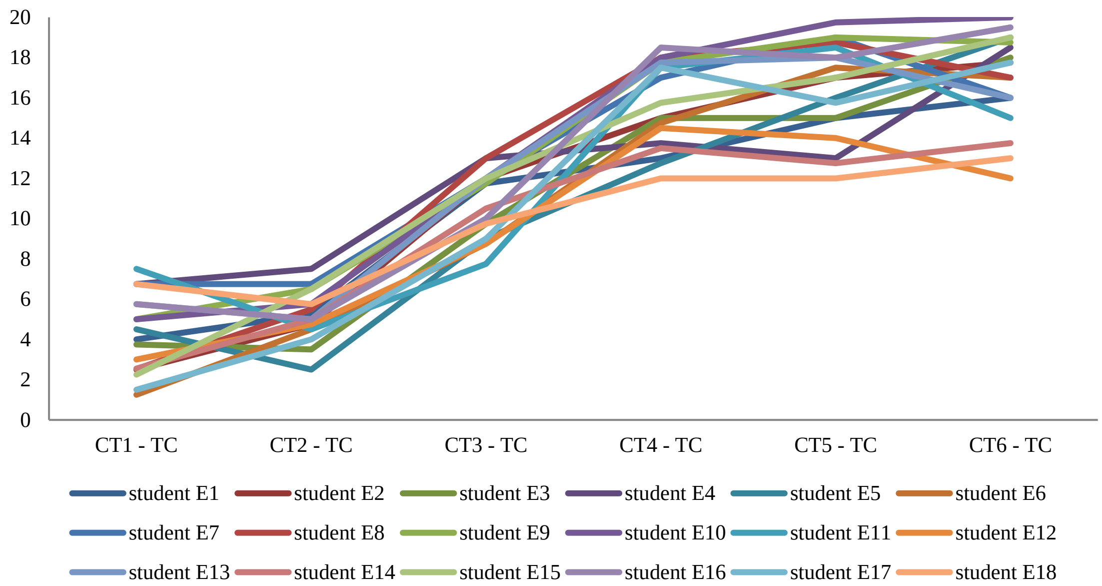

Figure 2. Grades of students in the experimental group of common core students

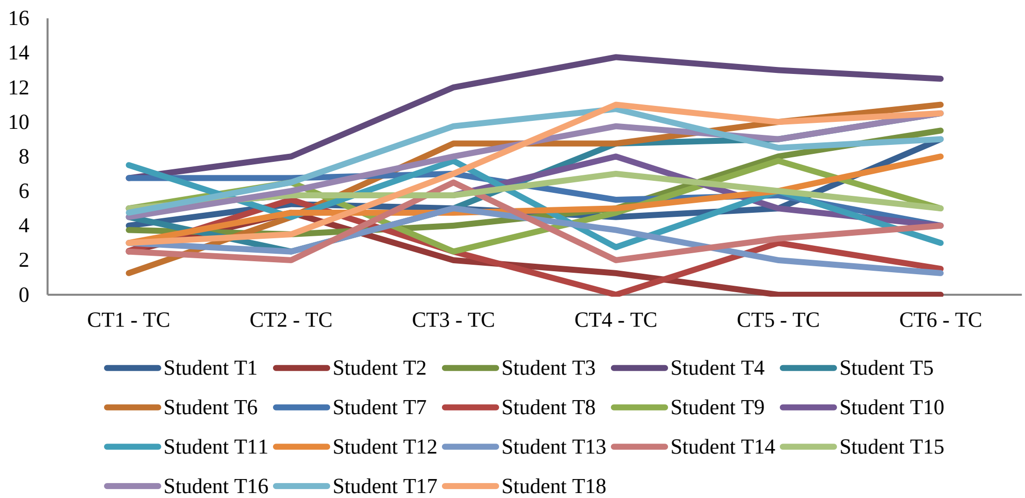

Figure 3. Continuous test scores of control group of common core students

3.2. Evaluation Phase of the System

3.2.1. Evaluation of Effect of Device by the Learners

The results of the questionnaire for the learners in the table below indicate that the majority of the participants declare their satisfaction with the use of this method in the physical sciences class.

Learners feel that the use of this method enriches and energizes the course content and therefore positively influences the motivation, participation, concentration and learning of physics learners.

These statements can be justified by the dynamic nature of the device and the variety of the proposed activities which encourage the active participation of the learners in the construction of their learning and that of their colleagues on the one hand and the identification and the exploitation of the representations of the pupils by the teacher as well as the learning difficulties which could only motivate them to participate more and to concentrate more.

Table 1. Results of the learner questionnaire

		Appreciation				
		Not satisfied	Not very satisfied	Satisfied	Very satisfied	Total (for favorable justifications)
Justifications - assessment	Makes the course clearer and more assimilable dynamic	2		183	25	208 (99.05%)
	Increase our motivation to learn the course	3	5	59	143	202 (96.19%)
	Increase our concentration to learn the course			85	93	178 (84.76%)
	Accelerate our learning and help us to know the maximum amount of information in a short time	14	40	91	45	136 (64.76%)
	Introduce more reality during the course session and facilitate the memorization of concepts			60	149	209 (99.52%)
	Increase our participation during the course			120	88	208 (99.05%)
	This method helps teachers adapt learning to the level and pace of each student.			13	197	210 (100%)
	Helps us to develop our observation and scientific reasoning	3	50	54	60	114 (54.29%)

The majority stated that this approach makes learning more accessible during the session and saves time so that learners can do more application exercises during the session. Regarding scientific reasoning among learners, 54% believe that this method promotes its development. In addition to these advantages, all the learners, subjects of the experimentation, declare that this method allows the teacher to adapt the rhythm of learning according to the rhythm of each student which could be explained, among other things, by the fact that the device based on the computer network, allows the teacher to detect the learning difficulties of each student Through the diagnostic quiz dedicated to this purpose to which each student answers at the request of the teacher. This allows the latter to react instantly to remedy the situation according to the criteria of differentiated pedagogy and the pedagogy of error.

The analysis of the typical comments associated with the unfavorable justifications and dissatisfaction declared by certain learners with regard to this approach, clearly shows that this use brings additional complexity during the course session in general, sometimes because of a lack of flexibility on the part of the teachers or a problem with the material and therefore the means.

3.2.2. Evaluation of the Effect of the System by the Teachers

The analysis of the answers collected from the survey carried out among 70 teachers of physical sciences in secondary schools with more than 10 years of teaching experience has allowed us to identify the positive and negative points of the experimental system. The results of the questionnaire are shown in Figure 4.

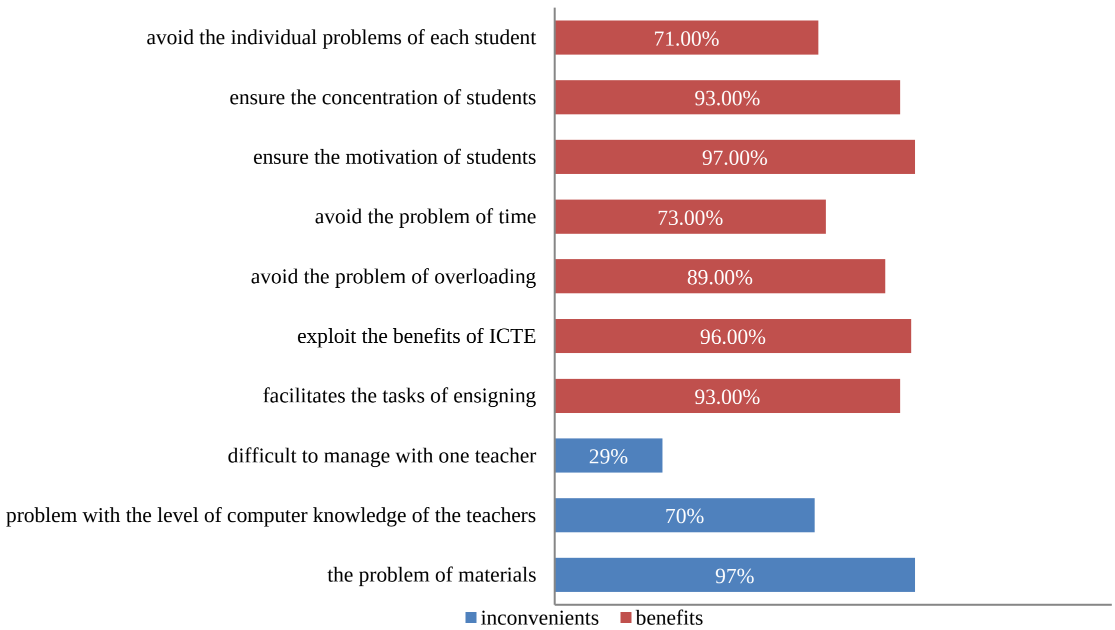

Figure 4. The teachers' point of view

The majority of teachers (93.00%) affirm that this method facilitates teaching tasks. (96.00%) of the surveyed teachers affirm that they can use this method to exploit ICT, peer learning and differentiated pedagogy without time constraints (73.00%) or class overload (89.00%).

71% declare that this device can solve the individual problems of each student (initial misrepresentations, problems with mathematics, shyness). 97% of teachers believe that students are more motivated and 93% say that the system also has a very positive effect on students' concentration in class.

Concerning the constraints of using the system, 97% of the teachers regret the lack of means in the high schools to use it. In addition to this, according to their statements, teachers' lack of skills in computer science and ICT. So, in order to motivate physics teachers to integrate ICT in teaching, it is crucial to train them in techno-pedagogy and to provide them with computer equipment and the Internet [21]. We note that 20% of the teachers feel that this approach is a little difficult to manage by a single teacher.

4. CONCLUSION AND PERSPECTIVES

Much has been written about the teaching of physics in high school, in particular about the difficulties related to learners' misunderstandings about learning mechanics or electricity. The overcrowding of the classroom and the time allotted to the busy curriculum make it even more difficult for teachers to manage the representations of the majority of learners and their learning difficulties in such a context.

In this study, we experimented with a teaching-learning device for physics in the core curriculum, based on tutoring and ICT. The objective being to try to bring solutions to the problematic linked to the constraints of adopting differentiated pedagogy in the above-mentioned context as well as peer learning while guaranteeing the improvement of the learning of all learners including the good, the average and the weak.

The results seem to be particularly interesting for learners whose level was initially low and who improved progressively and increasingly, unlike their counterparts who received the same courses but in a traditional manner. The tutored integration of ICTE allowed to identify and exploit the learners' representations as well as their difficulties and consequently allowed the teachers who experimented with the device to react instantly and to adopt differentiated pedagogy more efficiently. The teachers seem satisfied with this experimentation and believe that the integration of ICT in a tutored way allows to improve the concentration, the motivation of the learners and consequently the learning on the one hand and to overcome the constraints related to the overload of the class and the insufficient time allocated to the program on the other hand.

This study was conducted with a sample of students who had benefited from the common core program during their first and second year of high school. The results are currently being exploitation.

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