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The Impact of Integrating ICT in Teaching and Learning

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***Abstract* – On account of the importance of (ICT) Information communication technologies as the most essential catalyst for improvement, the Moroccan education system is in a quest to integrate Information and Communication Technologies in Education (ICT) to catch up with outperforming societies in this field. The aim of this study is to measure the integration rate of ICTs by secondary high school teachers of physical sciences and the barriers to the successful integration, and to evaluate the impact of introducing ICT in the teaching of physical sciences. To conduct this study, we established a questionnaire for 100 high school teachers working in the Casablanca-Settat region. We also evaluated the results of 300 students in 10th grade high school in the Casablanca-Settat district, during a lesson on electric tension which was presented to them in normal course for a 1st group, by introducing a simulation for the 2nd group and by introducing an experiment for a 3rd group chosen in a homogeneous way. The test results have shown that there is an improvement in the acquisition of skills in these students after attending classes by digital resources. However, the course presented with an experimental approach showed the best results. The experience also revealed a reduction of the teacher's task, a strong motivation of the students and an increase in interactions within the class group.**

***Keywords* – ICT, Physical Sciences, High School, Simulation, Experiment.**

I. INTRODUCTION AND BACKGROUND

The use of ICT is currently an asset by every measure. First, it is a requirement to keep up with the needs of globalization, and most importantly because the integration of these technologies contributes to the success of learning and would support active pedagogy. In fact, ICTs are increasingly establishing themselves as essential tools for the spread of knowledge, and especially as a source of motivation which necessarily influences disciplinary competence.

Karsenti et al asserted that information and communication technologies can help improve the students' academic performance if they are well integrated; and even if ICT can facilitate learning and make teaching more effective, they won't substitute the teacher nor the school missions [1]. What is more Bibeau affirmed that in certain contexts, ICTs become "intellectual partners" and give highly potent cognitive tools, but the pedagogical approach privileged in each context and the way in which the technology is implemented in class is what will play a crucial role in achieving these results [2].

Global investment in ICT to improve teaching and learning in schools have been initiated by many governments. Despite all these investments on ICT infrastructure, equipment's, and professional development to improve education in many countries, several factors influencing the adoption and integration of ICT into teaching have been identified by researchers.

In a perspective of improving teaching conditions and in accordance with international requirements, Morocc-

-o has adopted a strategy of generalizing the ICT integration to its education system. In this vision, the Ministry of National Education started in 2005 the GENIE program (Generalization of information and communication technologies in education) which aims at the generalization of ICT. This program, which was revised in 2009, targets 4 areas: infrastructure, teacher training, digital resources, and development of practices.

The review results, conducted by H. Mirzajani et al, show that most of the researchers believe that lack of enough training, lack of suitable software and hardware, lack of knowledge and skills, lack of ICT leadership support, lacking time, and lack of self-efficacy are the key barriers for utilization of ICTs in pre-service teachers' educational courses [3].

The study, conducted by Elouidadi et al., show that only a minority of respondents, 14 out of 1400 teachers surveyed, integrated ICT into classroom practice. The analysis revealed a reduction or even a virtual absence of any educational use of ICT. Several factors explain this rudimentary use of ICT: the information gap felt by teachers and their technical and techno-pedagogical qualifications, the availability of human resources and the lack of computer equipment in some schools [7]. Biaz et al demonstrate that 56.6% of teachers consider that the integration of ICT in the teaching of disciplines is very important, against 3.9% who consider that this integration is not important [6]. There are many constraints, ranging from under-use of installed equipment to the lack of professional development of the teaching staff and to poor local management. In terms of training, difficulties are raised, particularly of a material nature (logistical means, travel for teachers, subsistence costs, support, compensation for trainers) as well as difficulties related to the monitoring and supervision of training at regional and local level. About digital resources, the delivery of digital educational content validated by educational committees is still insufficient and requires the appropriation of these new educational materials and their efficient use [4].

The integration of ICT into the Moroccan education system was one of the priority measures and projects for the implementation of the educational reform of the 2015/2030 strategic vision, following the recommendations made by the Higher Council of Education, Training and Scientific Research (HCETSR), which aims to enhance the integration of educational technologies [5]. In 2016, 85% of schools in Morocco are currently equipped with a basic multimedia environment, 266,000 of the teaching staff have been trained in the field of use of ICT and 80% of digital resources comply with school programs requirements [8].

Physics, as an essential subject in secondary curricula, also benefited from the ICT revolution. Several studies argue that ICT implementation in physics offers many means of improving teaching and learning in the classroom. ICT educational technologies have the potential to support physics education across the curriculum, motivate learners, provide visual education to concertize abstract notions, support for effective communication between learners, and develop critical thinking skills and other competencies needed to work in an ICT-rich environment.

According to the pedagogical guidelines and official programs of Morocco, observation, and experimentation occupy a primordial place in the teaching of physical sciences, however, the teacher is in several cases confronted with the problems of the lack of materials and equipment needed in secondary school laboratory. In these situations, does the use of ICTs, even partially, constitute an efficient and profitable alternative?

To contribute to the evaluation of the impact of integration ICT in general and computer simulations in the te-

-aching and learning of physical sciences in senior secondary school (from 10th grade to 12th grade), research has been carried out on the level of teachers and students in several schools in Casablanca, in Morocco.

The work presented in this research attempts to test the following research hypotheses:

- Morocco having adopted a strategy of generalization of ICT, has led to its integration in most classes by most teachers of physical sciences of secondary schools in the region of Casablanca
- The introduction of digital resources in the teaching of physical sciences allows the improvement of students' performance and the acquisition of learning competences
- The use of ICT increases students' motivation when they are used in an adequate way.

II. METHODOLOGY

This study was carried out during the year 2021 when education opted for the hybrid mode of learning in private institutions and alternately in public education due to the pandemic of Covid 19.

Exploratory descriptive research in the Casablanca region enabled us to verify the integration rate of ICTs by senior secondary school physics teachers and to determine the constraints to their integration. To carry out this research, we established a questionnaire (see appendix) which, after validation, was distributed randomly to 100 teachers (70% age group between 51 and 60 years), working in the region of Casablanca-Settat, to see to what extent ICTs are used in their teaching and what are the obstacles that limit their use.

Then, we measured the impact of the integrating ICT in the teaching of physical sciences. Our sample consisted of 300 students of the 1st year of Moroccan senior secondary school, "scientific common core" (10th grade), from 5 establishments in the region of Casablanca. This sample was divided into 3 groups of 100 students with the same level. A pretest made it possible to choose groups of a homogeneous level.

To be able to measure the impact of ICT on improving the acquisition of skills in students, these 3 groups received a course on electrical tension. The first group G1 received a classical course. For the second group G2, the course was carried out using an experimental approach. For the third group G3, the experiment was replaced by a computer simulation. A post-test in the form of a questionnaire then made it possible to measure the impact of integrating ICT in the classroom.

III. RESULTS AND DISCUSSIONS

1. *Age Group of the Sample Studied*

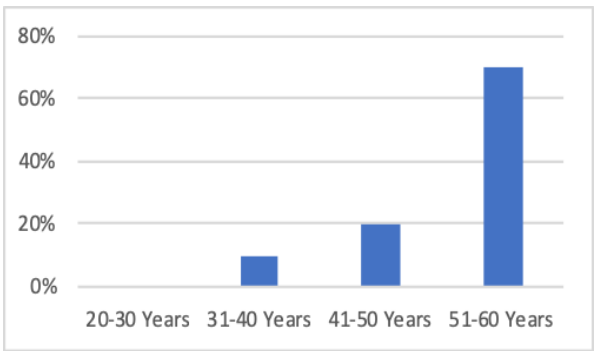


Fig. 1. Age group of our sample.

Most of the teachers interviewed had more than 26 years of accumulated work service and therefore could not benefit from the CRMEF training in the TICE unit. This unit was integrated into the CRMEF from 2012 and includes training in the adaptation of digital resources and their educational integration in the classroom.

2. *Use of ICT*

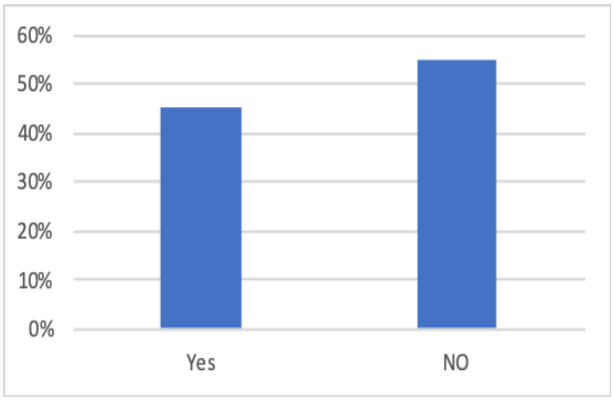


Fig. 2. Use of digital resources during activities.

45% of teachers surveyed in the Casablanca region say they use digital resources with their students as part of the activities. It can be said that there is therefore an enhancement of the integration of ICT in the classroom since Omar El Ouidadi et al affirmed in his study conducted in 2013, the reduction or almost absence of any pedagogical use of information and communication technologies in a classroom situation [7]. The survey revealed that only a minority of respondents (14%) out of 1,400 teachers, all sections combined, stated that they integrate ICT into their classroom practices.

3. *Frequency of use of ICT by Teachers who Integrate them into the Classroom*

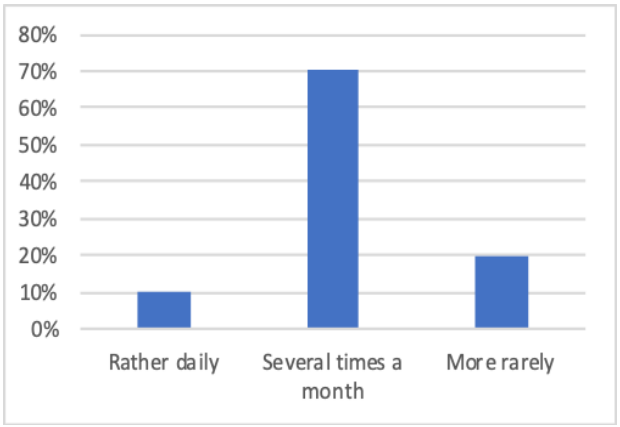


Fig. 3. Frequency of use of ICT.

Most teachers (70%), who use ICT, say they use it frequently in class, several times a month. During interviews with a few teachers in our sample, the latter justified the frequent use of ICT in their classroom teaching by the fact that their students seem more motivated, which had a positive impact on their academic performance. These teachers have noticed a clear improvement in the results of their students during their studies by having frequently integrated the ICT in class.

4. *Use of ICT by Teachers in Class*

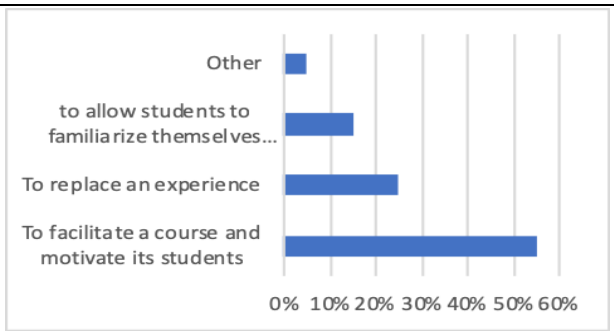


Fig. 4. Use of ICT by teachers in class.

Most physical science teachers, 55% of our sample, use ICT to animate a class session and thus motivate their high school students. 25% use it in the form of computer simulation to replace an experiment due to lack of material or in case of risk of the experiment.

The other teacher's response support the idea that the use of ICT in the classroom helps them improve the quality of teaching, promote student autonomy, and better manage the class.

5. *Objective of the Exploration of Some Sites*

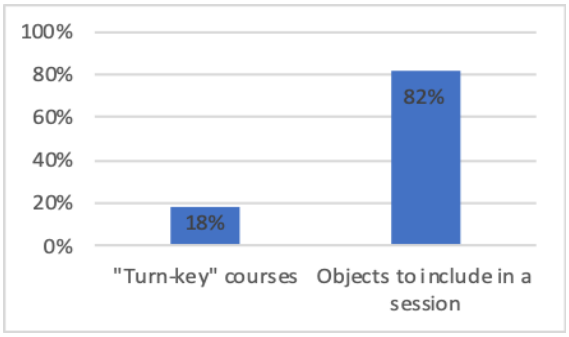


Fig. 5. Type of material used.

It is rather reassuring to see that the search for "turn-key" courses is not a major concern (18%) of respondents. Rather, it is objects to be included in a session that are sought at 82%, to implement a previously constructed scenario, to construct an activity aimed at making students work and acquire a particular skill. Indeed, an interview with 10 physical science teachers showed the value of using ICT in their teaching practices; digital tools promote a better ownership of concepts thanks to computer simulations.

6. *Types of IT Equipment Used in Class*

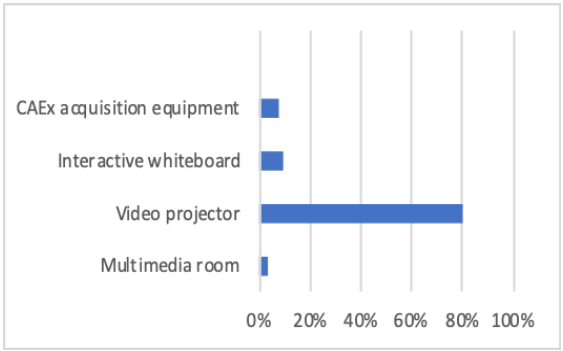


Fig. 6. Type of material used.

The video projector comes first with 80%: it meets a real need. Only 9% of digital tables are used; they could be used more, but not all rooms have them. Multimedia rooms are very rarely used.

The CAEx (computer assisted experimentation) represents a low rate of use since only 8% use it.

In fact, the interviews with some of these teachers enabled us to affirm that the low rate of the multimedia rooms use is stems from the fact that most questioned teachers require training in software from CAEx to be able to integrate it into the physical sciences class.

Also, the study by Gourja and al. (2016) showed a correlation between the lack of use of the CAE and several factors, namely: absence of training in CAEx, absence of CAEx equipment, or video projector, no maintenance of existing equipment in the establishment, high class size or an overloaded teaching program [9].

7. *Main Obstacle that Limits the use of ICT in Class in the Case of Teachers who Rarely or do not Integrate it*

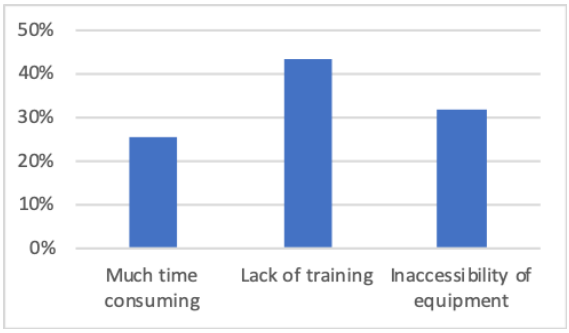


Fig. 7. Obstacles to integrating ICT.

31.62% of the teachers questioned mentioned access to material as a constraint on the integration of ICT in class. 25.38% of our sample say that ICTs are time consuming, knowing that ICTs require additional preparation and implementation time. But it seems that the constraint most cited by 43% of the teachers surveyed is the concern felt by the computer prerequisites required by the teacher. This concern forms the main obstacle to the use of digital resources in the classroom, hence the need for teacher training in ICT and their proper integration into the classroom.

8. *Analysis of the Evaluation of the Impact of ICT on Student Learning*

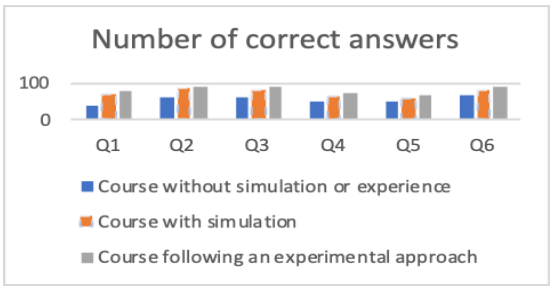


Fig. 8. Number of correct answers to the post test.

There is a noticeable improvement in the percentage of correct student responses to the test after receiving the course with simulation compared to the course without simulation. We can deduce that the digital educational resources have made it possible to improve the results of the pupils and can therefore constitute a promising

alternative for other didactic material to promote teaching and learning; on the other hand, the rate of correct answers to the post-test questionnaire decreases when we replace experience with computer simulation. Digital resources, especially computer simulation, are arguably a complement to physical science lessons, but they can never replace an experience.

Despite their limitations, real experiences are still necessary in learning the physical sciences. Indeed, these experiences develop skills and know-how that are usable in real problem situations [10]. Such as reading measuring devices, adjusting the position of various buttons, measurement of different physical values: mass, temperature, distance, elapsed time.

IV. CONCLUSION

Among the 100 secondary high school teachers questioned in the Casablanca-Settat region, 45% claim to use digital resources with their students as part of the activities despite certain preparation time constraints. The teachers mentioned a real need for a video projector. Digital boards could, on the other hand, be used more, but not all rooms are equipped with them. When it comes to teachers who do not use ICT in class, the main constraint mentioned is a lack of ICT training.

For the activities carried out with the students, the introduction of computer simulations in class allowed better assimilation of the course and therefore good post-test results compared to the course without computer simulation. But the results are better when we introduce the experience, which allows a better assimilation of skills, showing that digital resources can never replace the realization of experiences in the classroom; rather, they serve as a supplement.

Qualitatively, the course with the experimental approach revealed a reduction in the teacher's task, a strong motivation of the students and an increase in interactions within the class group.

APPENDICES

Appendix 1:

- Questionnaire for teachers.

1. Specify the age group to which you belong:

- 20 – 30 years.
- 31 – 40 years.
- 41 – 50 years.
- 51 – 60 years.

2. Do you use digital resources in course with your students?

- Yes.
- No.

If so, name where your digital resources come from:

- Digital manuals.

- Online disciplinary educational sites.
- Documentary resource sites.
- CD / DVD of documentary resources.
- Personal resources (slideshow ...).
- Others.

If not, rank in order of importance the top three barriers that limit your use of digital resources with students (1 = most important).

- Time consuming in class.
- Cumbersome preparation and installation.
- Fear of technical hazard.
- Concern given the IT prerequisites required at the teacher.
- Lack of real pedagogical gains in the use of digital resources.
- Implementation constraint.
- Inaccessibility of the equipment for an implementation.

3. If you are a user of digital resources, do you share them with other colleagues? Many possible responses.

- No, I am the only user.
- Yes, I share it within my establishment.
- Yes, I share it more widely (uploading in the academic pedagogical for example).

4. The digital resources you use are used instead:

- To animate a course.
- To place the students in the role of actors.
- For both.

5. When you explore different sites in order to prepare for courses, you are rather looking for: (you can tick more than one box).

- "Turn-key" courses.
- Objects to include in a session (animations, videos, images).
- Others.

6. When you search the internet for digital resources (videos, interactive exercises, sounds, animations, texts, etc.), you use (several possible answers):

- "National education" sites.
- Partner sites.

- Textbook publisher sites.
- Informal sites.

For which educational objectives do you lack digital resources? (You can tick multiple boxes).

- Learning a skill imposed by the program.
- Activation of the student.
- Help with understanding.
- Help in facilitating the course.
- Help for students requiring support.
- Others.

7. List the types of computer hardware or devices you use in your lessons. (You can tick multiple boxes).

- Multimedia room.
- Laptop.
- Video projector.
- Interactive whiteboard.
- EXAO acquisition equipment.
- Others.

8. You use these IT equipment or devices as part of your lessons:

1. Rather daily.
2. Several times a month.
3. Rather once a month.
4. More rarely.

9. Access difficulties limit your frequency of use of these materials or devices:

- Very often.
- Often.
- Rarely.
- Never.

Appendix 2:

- Test to measure students' skills.

For the sinusoidal voltage waveform, shown below, find:

1. Its frequency.

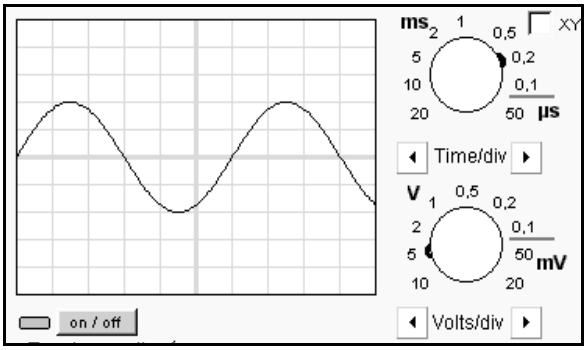
2. Its peak-to-peak voltage,

3. The voltage effective value.

4. What would happen if you placed a voltmeter in series with a component to be tested?

5. What is the basic operation of an ohmmeter as it measures a resistor?

6. What are the largest and smallest resistances you can obtain by connecting a $R_1 = 10\Omega$, a $R_2 = 100\Omega$, and a $R_3 = 200\Omega$ resistor together?



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