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IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGIES ON UNDERSTANDING OF EARTH SCIENCES BY LEARNERS

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Abstract- Learner's encounter difficulties in understanding and acquiring geological concepts. The integration of ICTE has a positive effect on the motivation of learners. They thereby make the act of teaching and learning scientific concepts more attractive and make knowledge more dynamic. The aim of this article is to find out whether the integration of ICTs in geology teaching contributes positively to the learning of learners and their attitudes towards geology. The research used the experimental method using an experimental group and a control group. Each group is made up of 30 individuals from a public school belonging to the Moulay Rachid Regional Directorate of the Casa-Settat Regional Academy of Education and Training during the second semester of the 2022/2023 school year. According to the diagnostic assessment report, these learners encounter difficulties understanding some geological concepts. All learners were tested in the form of evaluative exercises to test the impact of ICTE on geology teaching. The results showed that the use of ICTE among first-year middle school pupils yields positive results in terms of understanding and acquiring of geological concepts.

Keywords: ICTE, Concepts, Geology, Teaching and Learning, Learners, Middle School.

1. INTRODUCTION

ICTs refers to all computer, microelectronic, telecommunications, multimedia and audiovisual technologies that make it possible to find, store, process and transmit information in a variety of data formats (text, voice, still image, video, etc..) when combined and networked [1]. If these tools are used specifically in education, they become ICTE, which aims to facilitate and improve teaching techniques. Many initiatives have been undertaken to incorporate them into the Moroccan educational system. Since 1999, the education and training reform has placed the learner at the center of teaching activities by replacing old teaching methods with new, more modern ones based on a competency approach. In this perspective, Morocco's education policy has placed a strong emphasis on integrating information and communication technologies into teaching and learning, Lever 10; articles 119, 120, 121 of the National Education and Training Charter (1999) [2] emphasize that educational technology plays a decisive and growing role in teaching systems and methods.

The Moroccan state has invested a significant budget in the widespread use of ICT in education, highlighting their commitment to modernizing the teaching system and improving the way students learn to optimize their skills. The leaders have taken various measures and implemented many ambitious projects to integrate these technologies [3]. These projects include the emergency program, the "MARWAN" network, the Moroccan Virtual Campus (CVM), GENIE, the Nafida Project by the Mohammed VI Foundation for the Promotion of Social Works in Education-Training, Operation Injaz, the Taalimtice National Portal, and LAWHATI Program [4].

For Astolphi, et al. (1977) [5], ICTs have been chosen as a didactic means to promote learning. According to Endrizzi (2008) [6], the Internet is not just an environment for distance learning, it also contributes to the co-construction of knowledge. In their study, Depover, et al. (2007) [7] argue that information and communication technologies can play a positive role in teaching-learning, classroom interactions, and the creation of new pedagogical approaches. To clarify the importance and effectiveness of ICTE in the understanding and acquisition of geological concepts, the following research questions will be examined:

- What is the impact of ICT on geology teaching at middle schools?
- How can ICT improve Earth Science learning?

2. THEORETICAL FRAMEWORK

Several previous researches have stated that geological concepts remain rather complex and generally abstract phenomena, which pose assimilation and comprehension problems for learners. This discipline, which is an experimental and field science, requires practical work, but it remains challenging to realize it. According to a study by Najoui, et al. (2017) [8], practical activities in the classroom are extremely difficult to be conducted.

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These challenges are generally linked to the discipline and the Earth and Life Science syllabi, which are overloaded with few sessions dedicated to practical work or an insufficient hourly volume allocated for field trips. Crepion-obert (2002) [9], has shown that his students are unable to establish the relationship between the history of living beings and the mobility of tectonic plates, as well as the filiation between past and present aquatic and terrestrial living beings over geological time. Thus, Trend (2000) [10] underlines the difficulty of understanding geological time, and Monchamp and Sauvageot-Skibine (1995) [11], according to them, fixism prevents the understanding of dynamic phenomena that appear static on a human scale.

This obstacle could hinder learning the theory of plate tectonics based on the "mobility" of lithospheric plates. In the same sense, Gohau [12] states that "one of the difficulties in teaching geology lies in our inability to become aware of the immense durations of the Earth's past [...]". Finally, Chalak and El Hage (2011) [13], found that "Lebanese learners are less motivated for Earth Sciences compared with Life Sciences because of didactic or ideological obstacles as well as economic".

For Najoui, et al. (2017) [8], the problems encountered by the students of Earth and Universe Sciences at university are due to the difficulties already experienced when learning geology in middle and high school. In the same sense, there are added difficulties in relations with the subject, which is a field discipline, but the field trips aren't always scheduled due to administrative management, lack of logistical means, [14].

However, other researchers have pointed out the positive impact of ICTE in overcoming these difficulties. The work of Sayad et al (2020) [15] emphasizes that ICTE can be of great service to geology teaching, as they make illustrative geology documents available to students, and therefore assert that they have a positive impact on the teaching of Earth Sciences. As a result, according to (Maouni, 2014) [16], ICT can help learners assimilate the dynamism of inaccessible or slow geological phenomena through the use of flash animations to facilitate and perfectly illustrate geology lessons and practical work.

It has been clearly demonstrated that information and communication technologies can significantly enhance teaching practices, it is possible to significantly improve educational practice. Geology teachers can use this resource to present or introduce a teaching activity (PowerPoint, video, image, or documentary), or simply to illustrate it (image, documents, or graph,) in order to explain geological processes.

Orange (1987) [17] distinguished between two types of didactical in his research: on the one hand, planned lessons and exercises; on the other hand, simulation software in the context of teaching biology and geology. This author highlighted the effectiveness of simulation software. As regards modeling in space, the learner can benefit from the revolution of digital mapping using the Geographic Information Tools (GIS) [4].

According to aforementioned authors, ICT have revolutionized the teaching and learning of geology. It should also be noted that the success of geology learners will largely depend on how these techniques will be exploited, as the use of these tools must be accompanied by practical work or field trips because ICT alone should not replace this learning.

3. RESEARCH METHODOLOGY

3.1. Presentation of the Sample

To evaluate the effect of ICT on the teaching of geology in middle school, we conducted this study with a sample of 60 first-year middle school learners from the Moulay Rachid regional department of the Casa-Settat Regional Academy of Education and Training. These learners show difficulties in Earth Sciences according to the results of the diagnostic assessment report.

3.2. Data Collection Tool

Let's now present our data collection tool. We presented part of the "Steps of the Formation of Sedimentary Rocks" lesson, the part that focuses on the effect of erosion on geological landscapes. This lesson was presented through the integration of ICTE, notably through the use of flash animations, photos, and videos illustrating the action of waves and winds on geological landscapes.

Evaluative exercises were distributed to all learners at the end of the session. To measure the impact of ICTE, we compared the results of the exercises of this class with those in the control class. The specific element of our study (the effect of ICTE on geology learning) is not implemented in the control class. It's worth noting that the diagnostic assessment report indicates that students in both classes (control and experimental) have the same school level, giving us a homogeneous and comparable population.

Table 1. Characteristics of both classes

Classes	Class A	Class B
Workforce	30	30
Presentation of the lesson	Without ICTE Using documents (Control Class)	With the use of ICTE Video illustration and flash animation (wave action on Rocks / Wind action

Based on the results obtained from the assessment exercises, we divided the learners in each class into 3 categories according to threshold:

- Category 1: good mastery, with a threshold above 7/10
- Category 2: average mastery, threshold between 5/10 and 6/10
- Category 3: poor mastery, threshold below 5/10

4. RESULTS

Figure 1 shows a large difference in grades between the learners in class B (the experimental class) and class A (the control Class). According to the curves, we can see that the grades of the learners who benefited from ICTE are higher than those of Class A. These results clearly show the effect of this method on the learning of the geological concept in question.

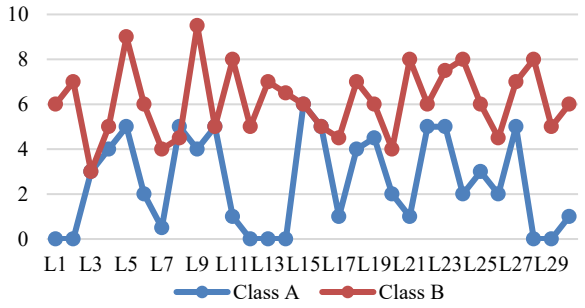

Figure 1. Grades of learners in the experimental and control classes

4.1. Class A Results

It should be noted that the results of the evaluative exercises were very low for this class, with most learners obtained scores below 5/10 (Table 2).

Table 2. Class A (control) evaluation results

Class A (Control)	Number of learners with a grade<5	Number of learners with a 5≤grade<7	Number of learners with a grade≥7
	22	7	1
Total	30 Learners		

These results revealed the presence of difficulties in explaining the phenomenon studied and the inability to apply knowledge in new situations. Based on the statistical results shown in Figure 2, the majority (73%) of the learners belonging to class A (control class) scored below average after analyzing their results, with 4% scoring between 5/10 and 7/10, while only 23% of the whole class reached the average.

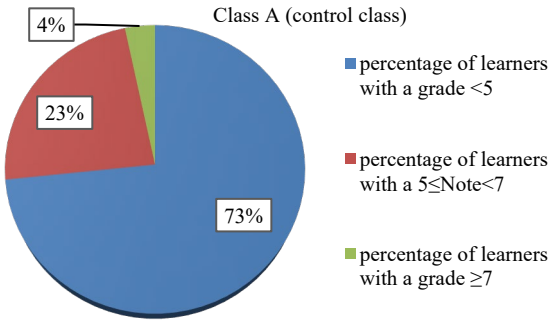

Figure 2. Percentage of learners in the control class

4.2. Class B Results

In order to test the impact of ICTE on the quality of geology learning, we present the lesson for this class by ICTE use, the results are as Table 3.

Table 3. Class B evaluation results

Class B	Number of learners with a grade<5	Number of learners with a 5≤grade<7	Number of learners with a grade≥7
	6	13	11
Total	30 Learners		

As shown in Figure 3, analysis of the evaluative exercises in class B revealed that 37% had an average above 7, 43% had an average between 5 and 7, and 20% had scores below 5.

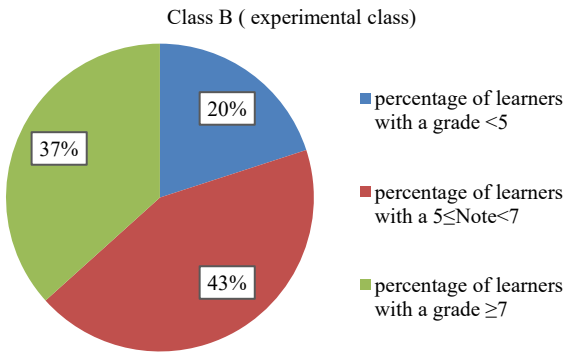

Figure 3. Percentage of learners in class B

We can see that there is a big difference in the results obtained by the two classes, as shown in Figure 4.

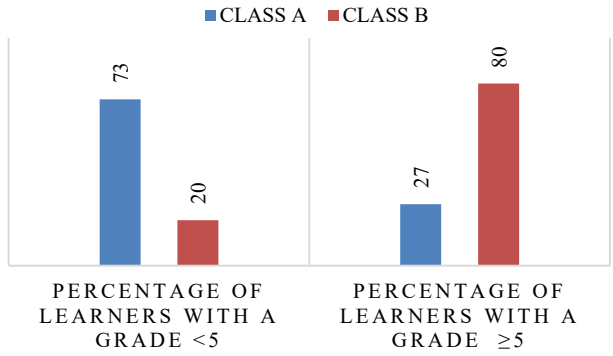

Figure 4. Comparison of percentages between classes A and B

In class B, 80% of learners scored above 5/10, compared to 20% of learners who scored below 5/10. However, in class A (control), the percentage of learners scoring above 5/10 (27%) compared to (73%) of learners scoring below 5/10.

5. DISCUSSION

In this study, the aim was to determine the impact of using ICTE on the teaching-learning of Earth Sciences and the understanding of the concept of erosion among middle school learners. The results of the present study show a positive impact of ICTE in improving academic results. They can help increase the success rate among learners mainly for class B, which was taught using ICTE. The integration of ICTE in geology teaching helped learners to assimilate the phenomenon studied and understand its action on geological landscapes, by integrating videos and flash animations illustrating the effect of erosion on beach rocks into the lesson presentation. The combination of field trips and classroom manipulations with the integration of ICTE would provide learners with an explanation to complex scientific problems and geological phenomena [18]. These technologies don't only make the act of teaching-learning scientific concepts more attractive; they also enable the evolution of representations and make knowledge more attractive; they also enable the evolution of representations and make knowledge more dynamic [19].

In the same sense, Karim, et al. explains that the integration of ICTE favors the concentration of the learner, which makes learning more beneficial, especially in the case of overcrowded classes and sessions with a limited timeframe [20]. Our results are also in line with those of Maouni, et al., who claim that learners could improve their learning by using digitized projections of Earth and Life Sciences course documents, especially if they were displayed on a plastic whiteboard on which the illustrations could be annotated in writing, making them more explicit. Also, using Flash animations to present geological phenomena, such as the formation of mountain ranges millions of years ago, can be summarized in a few seconds, giving learners the temporal and spatial perspective they need to follow these geological phenomena [16].

A study by Sayad, et al. (2020) states that among the causes calling for the integration of ICTE in geology teaching is the nature of the discipline, which appears difficult to explain, generally linked to phenomena that take place within the globe and on an imaginary spatiotemporal scale to middle school learners. Other studies have shown the importance of ICT in other areas of teaching, namely in mathematical sciences. The use of GeoGebra dynamic geometry software improves learners' attitudes towards mathematics and contributes to the learning and performance of even the weakest students [21].

Class A (control); on the other hand, did not benefit from ICTE during the presentation of the lesson. Accordingly, their results were very poor due to the nature of the discipline which is a field and experimental discipline requiring field trips and experiments. Consequently, in the case of lack of materials or the non-realization of field trips, ICTE could solve this problem by creating a space for interaction and motivation for learners and, above all, bringing geological processes closer together. In the same sense, Salami (1991) [22] has explained that the unavailability of laboratory equipment is one of the reasons for the non-realization of practical work in the classroom, making this discipline theoretical and arduous for learners. Consequently, the integration of ICTE into geological content can help to remedy for this obstacle and make possible the simulation of geological phenomena.

6. CONCLUSIONS

The results of the present research show that the integration of ICT has a positive impact on improving school performance and can help increase the success rate of learners in geology at middle school. We can clearly see an increase in the number of learners who have obtained an average grade and have therefore assimilated the concept of erosion, and this is particularly noticeable in class B.

The subject is abstract and difficult for students to learn; it's an experimental science that requires experiments and field trips. As a result, ICTE could solve this problem. ICTs enable learners to be more motivated and active in the construction of knowledge, to follow lessons more easily, and to understand more quickly. Finally, ICT improves teaching conditions and features high interactivity (text, image, animation, video, sound) [3]. Although the results of the present research have shed considerable light, in the Moroccan educational context, on a topic that has aroused the interest of many researchers internationally, new questions opening the way to further research and experimentation have been raised. As the teachers of Life and Earth sciences, we were able to observe that despite the Moroccan government's strong commitment to the integration of ICTE and its positive impact on the quality of teaching, it is not always integrated due to a lack of materials and equipment, the lack of training for teachers and the poor infrastructure in terms of information and communication technologies in our schools.

This reality provides us with a perspective to study the state of Moroccan schools in terms of ICT equipment. This finding is in line with the results of a study conducted by Ameziane et al, which showed that the results of ICTE integration are still insufficient and do not meet the expectations set by the Ministry [23]. The National Ministry of Education encourages innovation, the production and use of digital resources in different disciplines. Teachers must be equally skilled at using these resources, transforming existing ones, and adapting them to their own uses. That's why, continuous training shouldn't leave out two crucial aspects: Embracing digitization and empowering teachers as resource developers [24].

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