

The impact of information and communication technologies for education on improving student learning, and the consequences on the environment

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Abstract: Education is a right for all, and guaranteeing this right is the responsibility of all those involved. Similarly, information and communication technologies for education (ICTE) are now a basic element in the education sector. In the face of increasing changes and crises, the development of the education system and the improvement of the quality of student learning through the use of ICTE has been the subject of many researches. Thus, this article is interested in studying the impact of the integration of ICTE on improving the learning of school students in Morocco, while considering the environmental consequences emanating from this integration as an essential aspect in guaranteeing any sustainable development. To achieve this, the study was based on a rigorous methodology, involving statistical analysis using specialized programs and a questionnaire for school directors. The results of this study revealed the importance of integrating ICTE to ensure the improvement of learning, this being apparent across a number of aspects, especially those linked to student results, access to information and the acquisition of taught knowledge, and the effects on the environment. But this does not eliminate the importance of increasingly promoting a range of measures, namely equipping schools with technological resources and teacher training, to guarantee consequently the transition to a digital education enabling learning development, which subsequently has an impact on the environment.

Index Terms: Digital, educational system, environment, ICTE integration, impact, learning, Morocco, schools, teaching.

1. Introduction

In a world of perpetual change, education is an essential lever that lies at the heart of the concerns of nations, and it is the responsibility of all: leaders, teachers and partners, to mobilize all the necessary resources to ensure the development of means and practices, the usage of equipment, the promotion of education, e-learning and pedagogical innovation, which will help to overcome the changes. Among these means and tools there is the integration and use of ICT to dispense an innovative, modern, and quality education and thus improve students' learning at the school level, which will have an impact on teaching and more generally on the education system, to achieve the desired objective of optimal education, allowing to meet the needs of current and future generations and create at the same time a healthy environment. Thus, has given rise to a problematic question namely: To what extent can the integration of ICTE serve as a support for improving school students' learning in Morocco, and what are the consequences on the environment ?

In this sense, in the literature most definitions of ICTE come together and give the acronym ICTE as a generic term designating information and communication technologies that can be used for or in benefit of education [1]. So, the integration of ICTE can be a huge asset and a real support in the practice of teachers to deliver innovative teaching and guarantee an improvement in students' learning, which will also have an impact on the environment. But ICTE can also have undesired consequences. In a broader sense, teaching can be defined as the set of functions performed by a teacher, while learning is defined as an internal, interactive, cumulative and multi-directional process through which learners actively construct their knowledge and understanding [2]. Innovation is a process whose aim is an act of change and as a means to introduce elements or systems into an already structured environment [3]. Likewise, in education, the principles of innovation are the development of learnings, the discovery of new knowledges, and the acquirement of new competences [4]. In a world of ICT use, the question of improving the quality of learning and teaching by modernizing used tools, while taking into consideration technological evolution and the imperatives of the information society, makes it inevitable to debate ICTE research [5]. The use of ICT for learning can have both positive and negative effects on students' results [6]. On the positive side, the use of ICTE can improve access to information and resources for learning, make courses more complete, attractive, and interactive, increase students' flexibility and autonomy, encourage individualized teaching, and monitor student progress. On the negative side, the use of ICTE can distract students, weaken the need to work and discipline, reduce their creativity, and limit human interaction between students and teachers. The specific effect of ICTE use on students may vary according to whether positive or negative effects predominate [7]. Using ICT to enhance climate action (SDG 13) requires an understanding of the environmental impact of ICT, since previous research has seen ICT as a two-sided coin. In fact, ICTs are both detrimental and beneficial to the environment [8]. Furthermore, the results of a study illustrate that improving education also has an impact on environmental quality, since it enables the adoption of technology and innovation in the country, which can reduce environment pollution [9]. So, ICTs are an essential means to encourage growth and limit environmental damages [8]. For a number of years now, Morocco has been mobilizing efforts, especially via its Ministry of National Education, to promote digital education through the widespread use of ICTs in the national education system. This led to the launch in 2005 of the GENIE (Generalisation Of ICTs In Education) program, which is an ambitious national initiative with a three-pronged strategy focusing on infrastructure, training for teachers, and contents development [10]. This program deployment is therefore monitored and its objectives are updated. Similarly, the integration of ICTE has taken an important place in various educational programs and reforms, citing the latest one, the strategic vision of reform 2015-2030, through its foundation for a quality school for all, emphasizing the need to strengthen the integration of educational technologies by implementing a national strategy that will place them at the service of learning quality at program and training level [11]. Also, project n°14, concerning the application of the latest framework law 51-17 promulgated in 2019, relating to the system of education, training and scientific research, is devoted specifically to developments in the use of ICTE. In the same vein, given the place and importance of ICTE, which has radically changed the world of education, its integration into the educational sector has been the subject of a number of studies and research projects involving several disciplinary fields (pedagogues, practitioners, managers, etc.), but this does not mean there is no need for increasing researches to answer a number of existing and emerging questions with the development of practices. In this context, despite the efforts made by those in charge before and even after covid-19, the concretization of ICTE integration objectives is developing slowly and still limited by numerous obstacles. Thus, it is in this context that this research work takes part. Given the importance of ICTE, our objective in this paper is to focus on the impact of ICTE on

improving student learning at the level of one of Morocco's prefectures, especially at a very important age, that of compulsory education, as stipulated in the first space (Making compulsory schooling effective up to the age of 15) of the emergency program 2009-2012, which devoted project 10 to the integration of ICTE and innovation in learning [12], so as to have a vision of their importance, to encourage the promotion of the use of these means and tools more and more, which will also lead to important consequences on the environment. Based on the above, in order to respond to the problem and achieve our central objective mentioned earlier, we have chosen to translate this central objective into two specific objectives, as follows: 1) to carry out a study on the impact of the integration of ICTE on improving the learning of school students in one of Morocco's prefectures, and 2) to attempt to determine the consequences of this integration on the environment. Thus, the aim of this article is to highlight the importance attributed to ICTE in ensuring a learning of quality, the efforts deployed to ensure their implementation through educational policies and programs in Morocco, and the consequences on the environment. Then, using a rigorous method, we carried out an empirical study in one of Morocco's prefectures, especially the prefecture of Meknes. As a result, this research work will lead to an original result with a major goal: on the one side, to create added value in the world of scientific research, especially in a field that is at the heart of worldwide preoccupations, and on the other, to put forward suggestions that can further improve the impact of the integration of ICTE on student learning, and at the same time on the environment at the local and national levels. In addition, to allow those in charge of the sector to achieve outcomes concerning the impact of ICTE on student learning.

2. Article Maps

This research paper, is divided into six parts. We begin with a general introduction, then we outline the research methodology, we present the results obtained, and we continue with discussion and suggestions. Finally, we finish with a conclusion and acknowledgement of the research contributors.

3. Methodology

3.1 Choice of method

After presenting our subject in the introduction, set out the problematic, the central and specific objectives, we further explain the choice of the methodology to meet our request. Thus, we opted for a quantitative methodology permitting the measurement of phenomena and the quantification of relationships between various elements [13]. We used, a descriptive statistical analysis, which is a strategy that reduces the data collected to a summarized number using numerical and graphical techniques [14]. The adoption of this choice enabled us to describe, summarize, and represent the data collected in a synthetic, clear, efficient, practical, and easily compressible form for the reader, which will permit the achievement of the study's objectives.

As mentioned in the introduction, this study was conducted in Morocco, specifically in the intervention field of the Ministry of National Education direction in the Meknes prefecture, over a period running from March to May 2023.

3.2 Data collected

We founded the search for answers to our work on the basis of a questionnaire survey, defined by Hap in 1990, to collect information [15]. The principal purpose is to gather a large quantity of both factual and subjective information from a wide number of people [16], which made it possible to gather indicators by collecting the necessary data for this study. This questionnaire was created and intended for the directors of elementary and middle schools (the age of compulsory education) located throughout the Meknes prefecture. Made up of a random sample of 81 schools, figure 1 below presents a description of our study sample, which is composed of the directors who responded to the questionnaire with a number of information items, namely: the directors' gender, school cycle, area, and the total number of students in their schools.

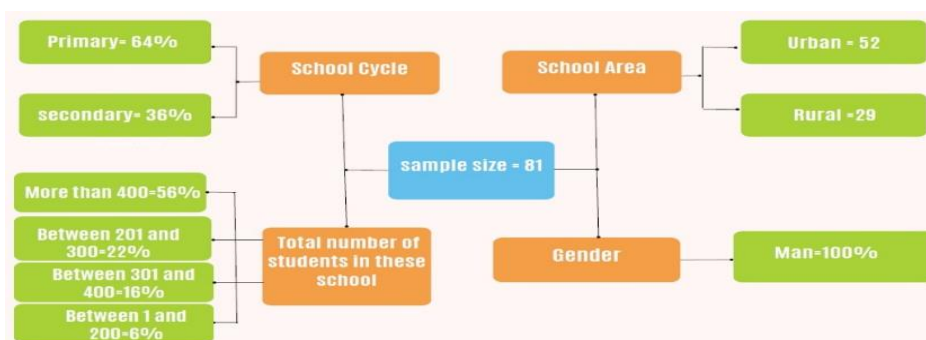


Figure 1: Description of the study sample.

In order to facilitate the task and take full advantage of technological progress, this questionnaire, carried out via the Google forms platform, has allowed us to opt for electronic diffusion via the means of information and communication in the form of groups on the social networks that bring together all the elementary and middle school directors in Meknes, as well as by email. In this way, we were able to cover the majority of communes and areas in the territory, with the aim of obtaining a representative sample. To ensure IT treatment of the questionnaire, we used a professional laptop and specific software dedicated to processing, to scientific and practical analysis (Excel, SPSS,...).

Then, by coding the variables, carrying out cross-analyses and calculating the indicators (number of schools, school results, ICTE training, improved learning, effect on the environment, etc.), we were able to obtain data in the form of (tables and graphs), which are important and essential for answering the problematics and the study's objectives, and that will be presented in the next part, which concerns data analysis.

4. Results and data analysis

4.1 Study of the integration and utilization of ICTE in the prefecture's schools:

The figure below, focusing in a first question on the disposition of ICTE in schools, shows that according to the answers 67 of the schools (83%) express their ICTE dispositions, while the remaining 14 (17%) deny their dispositions. In addition, the answers to the second question of the same figure show that for the 67 schools with ICTE, we note that 58 of the directors (86.56%) indicated the use of these technological resources by teachers in the classroom for the benefit of their students, while 9 (13.43%) expressed the non-use of these resources by teachers (See Figure 2).

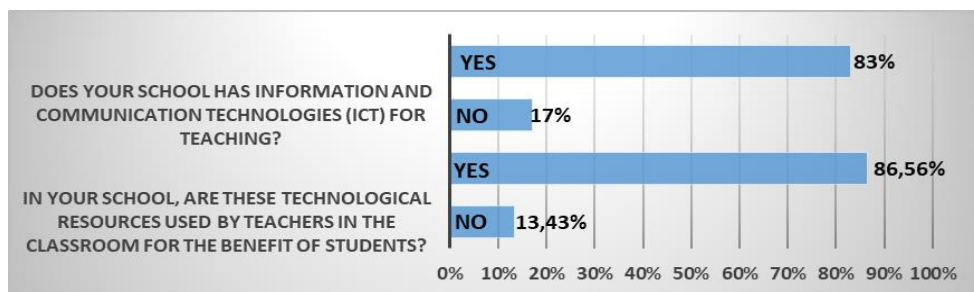


Figure 2: Disposition and use of ICTE in educational establishments.

4.2 Study of the impact of ICTE on improving student learning and the consequences on the environment:

The table 1 shows the directors responses to two important questions. In the first question concerning the impact of the integration and use of ICTE by teachers on improving student learning, the majority 79 (97.5%) confirmed this impact with a "yes", while 2 (2.5%) answered with a "no". The second question is addressed to those who answered "yes" to the first one, in order to express the nature of this improvement through five choices. The answers are as follows: 82.3% for a better acquisition of the knowledge taught; 73.4% improving students' school results; 62% for improved access to information and learning resources; 71% for making courses more complete, attractive and interactive; 57% for allowing pedagogical innovation which improves learning (See Table1).

Table 1: Impact of ICTE on improving student learning.

Does the integration and use of information and communication technologies by teachers have an impact on improving student learning?		If yes, this learning improvement is achieved through (multiple-choice question)?				
NO	YES	Better acquisition of the knowledge taught	Improving students school results	Improved access to information and learning resources	Make courses more complete, attractive and interactive	Allows pedagogical innovation which improves learning
2.5%	97.5%	82.3%	73.4%	62%	71%	57%

Regarding the environmental consequences of integrating ICTE into student learning, for the majority of directors (90%), the consequences are positive, while the remaining 10% find them negative. Likewise, the directors judged these consequences through 3 choices as expressed in the table below (See Table2).

Table 2: The consequences of ICTE use on the environment.

Does the integration and use of information and communication technologies in student learning have consequences on the environment?		According to you, what are the consequences on the environment?			
Negative	Positive	Reduced consumption of traditional teaching tools (paper, chalk, chemical substances, etc.)	Teaching students to use technology in their lives, which will have a positive impact on the environment.	Encouraging ecological school activities through the use of technology	Other answers
8	73	59	58	55	0

5. Discussion

The purpose of this section is to present an interpretation and general discussion of the obtained results, in order to provide an answer to our research questions and the objectives set out in the introduction. After identifying our sample of 81 schools, including 52 elementary and 29 middle schools, we moved on to the first part of the study. We noted from the results of the questionnaire that 83% of schools are equipped with ICTE, while 17% are not, which can be seen as a negative point for the generalization of ICTE in all schools. Among the schools equipped with ICTE, the majority confirmed the use of these resources by teachers in the classroom as part of their pedagogical practices.

Concerning the impact of ICTE integration and use by teachers on improving student learning, most of directors confirmed this impact with a "yes". In the same spirit, they expressed the nature of this improvement in learning via five choices: 1) this improvement is achieved through a better acquisition of the knowledge taught, 2) by an improvement in students' school results, 3) through an improvement in access to information and learning resources, 4) via making courses more complete, attractive and interactive, and 5) through pedagogical innovation, which improves learning (table 1). Thus, these results are consistent with the literature, which emphasizes that both positive and negative effects can be generated by the use of technology for learning. Hence, based on the results of this part, we can conclude that the integration of ICTE can be a real support for improving the learning of school students.

For the last part, we examined the consequences of the integration and use of ICTE in student learning on the environment. The majority of directors admitted that these consequences are positive. In addition, they translated their perceptions of the consequences on the environment into 3 choices presented in (table 2). Thus, we note 59 responses in favor of reducing the consumption of traditional teaching tools (paper, chalk, chemical materials, etc.), 58 in favor of teaching students to use technology in their lives, which will have a positive impact on the environment, and 55 for encouraging ecological school activities using

technology. This ties in with the literature presented at the start, which expressed the idea that the adoption of technology in education can have effects on the environment. In view of the above, we can say that the integration and use of ICTE in student learning can have several consequences on the environment.

Admittedly, the results of this research work have enabled us to elaborate important statements to meet our objective of this study. However, as this subject directly concerns teachers and students, we decided to adopt a perspective aimed at targeting them, and to reinforce the quantitative method used, with the qualitative method, in order to understand their way of thinking.

6. Conclusion

In conclusion, after presenting the research question, which aims to focus on the impact of ICTE integration on improving the learning of school students in Morocco, and the consequences on the environment, which has been approved based on the results. Thus, the findings of the empirical study show that the real integration of educational technologies can improve students learning, and this can have several consequences on the environment. On one hand, this gives new research opportunities, involving categories such as teachers, other territories, and more aspects such as pedagogy, to further study the place of ICTE to reinforce assets and rectify shortcomings. On the other hand, in order to really achieve the desired objectives, this work suggests developing a series of measures:

-Develop the availability of technological resources for education in schools and the digital production of courses, activities, etc.

-Reinforce the use of ICTE in teachers' practices to better improve student learning and promote basic infrastructure.

-Promote a sustainable digital culture in the entire education system, by integrating the interest of the environment with a participatory approach involving all important parties.

-Ensure the training of teachers in ICTE to develop innovative practices [17].

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