Teacher's Perceptions of STEM Education at the Primary Level in Morocco

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Abstract—STEM education is critical in developing students' interest in science and technology. Primary schools establish the groundwork by teaching fundamental technology ideas. Digital programs are favored over old paper-based approaches in response to current demands. The essential objective of this research is to show how information and communication technology (ICT) can improve the quality of teaching, learning, and motivation among primary school students. A questionnaire has been sent to 80 teachers at elementary schools, and a quantitative methodology was utilized to examine their thoughts. As an evaluation instrument, an eight-question quiz has been utilized to assess the usefulness and significance of ICT in promoting active and autonomous learning, resulting in creating a student-centered education approach. According to the research, the majority of teachers support the use of ICT as an of use pedagogical tool that fosters a proactive learning culture in young learners.

Keywords—ICT, teacher's perception, motivation, primary school, STEM

1 Introduction

The domain of education has been witnessing an unprecedented growth of technology, which has revolutionized educational practices for both learners and educators [1], [2]. This article aims to investigate the transformational impact of Information and Communication Technology (ICT) on the role of teachers, who are no longer mere knowledge deliverers but rather co-constructors of knowledge with their students. With the advent of ICT, learners have become active participants who interact with their environment, including teachers, peers, and various learning tools, to co-construct their knowledge. Since the 1970s and 1980s, the integration of computers into education has given rise to several practices and applications that complement traditional educational methods. A range of terminologies, including "computer-based educational applications", "computer-based education", "new educational technologies", "new information and communication technologies in education", and "information and communication technologies in education", have emerged to describe the integration of technology in education [3]. Although the term "ICTE" lacks standardization, it is widely adopted in academic circles to refer to ICT in education.

Advocates of ICTE contend that it has the potential to enhance learning by increasing motivation, personalizing learning, catering to different cognitive profiles, and making learning more engaging and interactive [4]. Several studies have shown that learning activities using ICT lead to higher student motivation than conventional classroom methods.

In recent years, this has given rise to an umbrella phrase in education known as "STEM," and these fields share an educational trend. STEM education arose in the early 2000s, and the National Science Foundation was founded and its enormous budget supported in the mid-2000s. STEM education is largely concerned with the sciences and mathematics, as well as technology and engineering [5].

In Morocco, primary school teachers typically use a traditional approach to teaching STEM, making it difficult for learners to grasp STEM ideas. That is why we attempted to conduct this research using ICT. We want to show how ICT may be utilized to increase the quality of STEM teaching and learning, as well, as how ICT integration inspires primary school pupils to focus on the teacher's explanations. The purpose of this paper is to investigate elementary school teachers' perspectives about STEM education and the application of ICTE in Morocco. The study seeks to address the following question: What factors influence primary school teachers' perceptions of the integration of ICTE in STEM education in Morocco?

This article has been separated into four sections: The state of the art, the research methodology, results and discussion, and a conclusion.

2 Literature review

Morocco's government and Ministry of National Education want to strengthen education and match it with global development. In 2005, they established the GENIE initiative to integrate Information and Communication Technologies in Education (ICTE) into classroom instruction, increase teaching quality, and change curricula accordingly. These adjustments are intended to improve retention of learners [6]. The GENIE program's objectives include encouraging active student participation in course development [4]. ICTE is viewed as a humanitarian pedagogical tool, notably within Vygotsky's (1934) socio-constructivist perspective. By taking into account the social sphere of education, socio-constructivism facilitates the development of long-term knowledge. The socio-constructivist then introduces an additional dimension to the construction of knowledge: multiple social interactions, communication, co-construction, and co-elaboration. With the help of the teacher, participation as a knowledge mediation tool will allow students to modify their level of abstraction and thus adapt to new perspectives [7]. The purpose of this article is to explore the perspectives of primary school teachers on STEM education and the application of ICT in Morocco. What are the benefits of integrating ICTE into the Moroccan education system, and what is the importance of STEM education?

2.1 Advantages of the integration of ICTE

The integration of ICTE in the education system leads to changes in practices. In general, ICTE offers new possibilities and encourages innovation. Among the potential benefits, they provide a wide range of media and resources. They enable empowerment in the workplace through open learning or «free» self-study, but also through collaborative learning and the development of technological skills that are in high demand in the digital age and in the knowledge society [8]. ICT is a fundamental lever through which neuroscience contributions to learning can help learners progress. The teaching community has significant challenges in the cognitive sciences. ICTs, on the other hand, offer chances to improve learning by enriching content, promoting interaction, and personalizing training. Learning processes are improved by combining cognitive science and digital technology. Attention, active involvement, feedback, and consolidation are crucial components for improving pedagogical approaches, according to Stanislas Dehaene [9]. The integration of ICT in education has changed the role of the teacher. ICT supports the adoption of a pedagogical approach that makes the student the actor in his or her own learning. The integration of ICTE favors the development of transversal skills. In fact, when the student carries out disciplinary and technological learning, he has the opportunity to complete his studies in a favorable ICTE context, which serves the development of intellectual skills such as critical thinking [10]. The introduction of information technology is the main concern and driving force of the Moroccan government [11]. Also to the creation of the national observatory for the use of information and communication technologies in education and the creation of the National Laboratory of Digital Resources, which monitors and manages the production and acquisition of educational resources [12]. We are interested in the integration of ICTE in primary education and, more specifically, in STEM education because there is still a very significant lack of rigorous research being conducted to better understand the reality of ICTE integration in primary schools in Morocco.

2.2 STEM education and their importance

STEM education refers to teaching and learning in the fields of science, technology, engineering and mathematics[13]. It covers all grade levels from preschool to post-doctorate. In recent years, there has been a well-known concern in the United States and other countries about the development of future scientists, technicians, engineers and mathematicians [14]. Dr. Judith Ramaley, NSF's associate director of education and human resources, coined the acronym STEM in 2001. He defined STEM as an educational inquiry that places learning in a context where students solve real-world problems and create opportunities [15]. STEM education refers to how teachers integrate some or all the four disciplines of science, technology, engineering and mathematics based on the relationships between the subjects and real-world problems [16]. Johnson revealed that STEM is "an educational approach that integrates the teaching of science and mathematics disciplines through the integration of scientific enquiry practices, technology planning and design, mathematical analysis" (p. 367). Recently, Martin-Paez et al. argued, STEM education must be based on the STEM

curriculum standards, creating experiences that allow students to develop STEM skills [17].

The importance of STEM education is discussed by organizations and promoted by businesses and the media [15]. Students can understand the relationship between information from disparate fields through integrating STEM education across science, technology, engineering, and mathematics. It is feasible to boost student interest and achievement in related fields by implementing effective STEM thematic activities. However, because STEM education is multidisciplinary, it can take a long time to construct a STEM course [18]. STEM education is an interdisciplinary approach that reinforces critical thinking and inquiry practices used in science, technology, engineering, and mathematics courses. Instead of teaching the four disciplines as separate subjects, STEM integrates them into a unified learning paradigm based on real-world applications [19]. A true STEM education should give students a better understanding of how things work and improve their use of technology [20].

STEM education seeks for learners with globally competitive abilities, bridging the gap of education and future jobs. Strong STEM skills guarantee a successful professional route. Teachers must evaluate student characteristics, teaching methodologies, and the implementation of the integrated approach when implementing STEM education. STEM is the integration for mathematics, science, technology, and engineering, with mathematics used as a key subject alongside these other fields [22] [23]. Students and teachers enjoy the availability of searchable digital content and technologies including hyperlinks and search engines. ICT improves schools in three ways: it fosters a knowledge society, it recognizes the importance of ICTE for the visibility, cost-effectiveness, and quality of education and it understands the function of ICTE in the learning cycle. These elements help improve educational access, efficiency, and learning results [23].

TEM activities have grown in popularity in school curriculum because they encourage a hands-on, integrated approach to learning that emphasizes solving issues, critical thinking, and imagination. Including STEM subjects into school curricula has been a priority in many countries. Wajeeh Daher and Juhaina Awawdeh Shahbari's study provides insights into the experiences and perceptions of prospective instructors who will be in charge of executing these initiatives in the future. This knowledge can be used to create educational policy and curriculum improvements with the aim to promote high-quality STEM education [24].

[25] study the effective use of technology in education, focusing on robots, mobile apps, and STEM tools for primary and preschool students. They offer advice to teachers on how to maximize the benefits while reducing the risks. The study underlines the importance of hands-on experiences in understanding scientific and math ideas and identifies chances for learners to interact. With the incorporation of technology, their research strives to improve effective and engaging learning processes.

Children's experiences in their early life shape their lives in the following years. Therefore, it is now recognized that starting learning with STEM education in early childhood has positive results in the future. The skills of children supported by STEM education include all 21st century skills. It is an area suitable for developing problem solving, collaboration, creativity, communication and critical thinking [13]. The results

from various international research shed light on various perspectives on education in the digital context, focusing on mathematics challenges and opportunities, the use of educational apps, STEM education, the integration of technology into instruction, and teacher education in early childhood education. The research, on the opposite the moment, investigated parents' impressions of the use of educational applications for preschoolers, emphasizing the importance to create valid measures to assess these perceptions. The use of technology into instruction was also investigated, emphasizing the advantages of multimodal educational resources and adaptive gamification tools to improve learner learning and engagement, particularly in the sciences [25-30].

3 Method

3.1 Research design

The purpose of this article is to investigate the views of primary school teachers on STEM education and the application of ICTE in Morocco. Our research targets Moroccan primary school teachers working at the Provincial Directorate of Education and Training of Sidi Kacem under the Regional Academy of Education and Training of Rabat, Sale, and Kenitra, Morocco, who teach STEM. The research was conducted using the descriptive survey method, a quantitative research approach. The descriptive survey design is used to learn about the attitudes and opinions of primary school teachers who teach STEM. To achieve the objective of this research, a questionnaire was administered to eighty (80) elementary school teachers, divided into several school groups. Multiple-choice questions were chosen to facilitate the data analysis process. To make the questionnaire usable, we submitted the draft questionnaires to the inspectors of mathematics, science, and technology for this cycle, who have more than 20 years of teaching experience in the primary schools. Their recommendations were taken into account.

3.2 Participants

The participants in the study were 80 volunteer teachers working in urban, semi-urban, and rural schools with different years of experience in primary school. They were selected by simple random sampling using the quantitative survey method. The study shows that a total of 80 primary school teachers participated in the study, of whom 43.75% (n = 35) were female and 56.25% (n = 45) were male.

3.3 Instrument

The anonymous questionnaires that comprise of eight questions has been developed for use as a research tool. The methodology used is divided into four phases, which are validation, administration, retrieval, tabulation, and data analysis. In the validation phase, the questionnaire was carefully prepared, taking into account the research objectives and the information required to accomplish those objectives. This guarantees

that the participants are representative of the research population. We received 80 responses, yielding a very high response rate of roughly 40%. A high response rate is often regarded as an advantage since it shows that participants were willing to participate in the survey, which may increase the validity of the results. We tabulated and analyzed the acquired data before receiving the questionnaires. This entails entering the results in a database or statistical program, evaluating them, and drawing conclusions and answering the study questions. Data collection process in this research lasted for a five month. The items are as follows:

- Q1: Do you have a computer at home?
- Q2: Do you use simulations in your experiments?
- Q3: Is there a multimedia room in your institution?
- Q4: Is there data show in your school?
- Q5: Do you use ICT?
- Q6: Which subject most requires the integration of ICTE?
- Q7: What do you think about teaching with digital technology?
- Q8: Do ICTs help students understand a concept?

The following flowchart describes the methodology of this study:

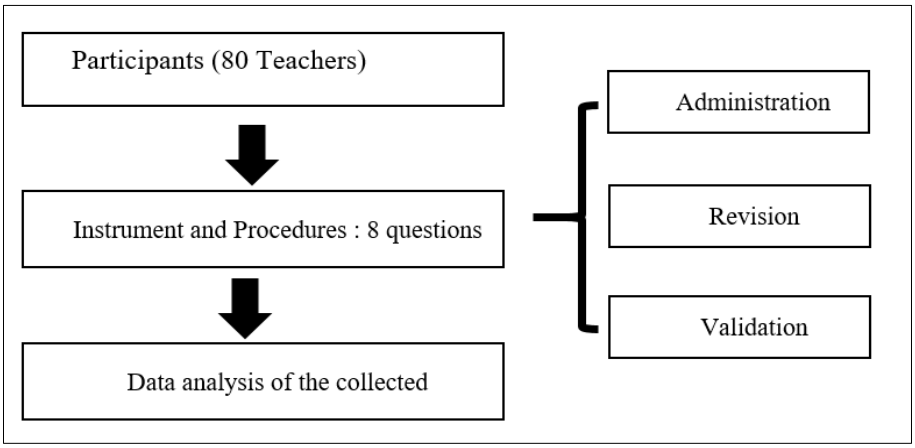

Fig. 1. Study Methodology

4 Results

4.1 Personal use of ICTE

According to the results obtained (Figure 2), 98% of teachers declare having a computer at home, and only 2% do not; 95% of the teachers surveyed use simulations in their experiments, and 5% do not use simulations (Figure 3). The primary

pedagogical purpose of modeling and simulation-based learning is for students to construct knowledge by means of modeling scientific phenomena.

Simulations are used to assess student performance in a virtual environment where activities and performance are recorded. Simulation exercises are useful when the activity they replicate is dangerous, costly, and difficult to set up, too complex or too time-consuming to perform; they also allow students to make mistakes without being penalized [31]. Others describe educational simulations as a simulated real-life scenario presented on a computer, in which the student plays an authentic role in performing complex tasks [32].

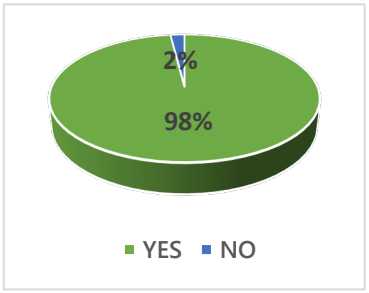

Fig. 2. Personal computer at home

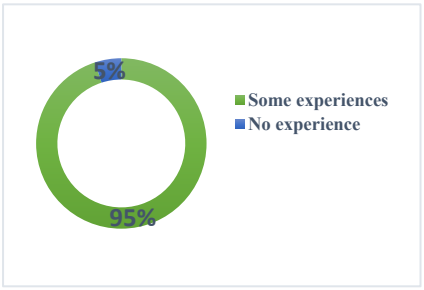

Fig. 3. Integration of simulations into experiments

4.2 Digital workspaces

According to the results obtained, 0% of teachers have a computer room in their school. While 100% of the schools do not have one (Figure 4). Teachers utilize their personal laptops to provide the school's prepared courses.

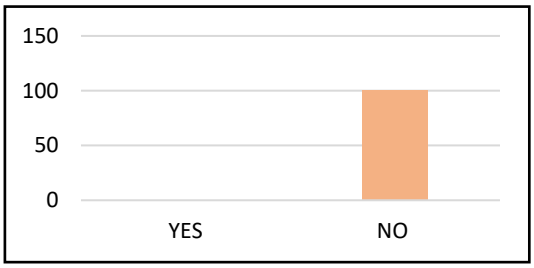

Fig. 4. Computer room in the school

The ICTE has become a pedagogical means and is characterized by an increasing richness. We notice that scientific activity has become digital to replace the lack of experimental material and also to attract the learner's attention to follow his learning with motivation, save time of learning, and make connections between the knowledge to study and the learners' daily lives. Nevertheless, in spite of all these advantages of

using these technologies, there are still issues that reduce the effectiveness of these technologies.

4.3 Teaching with digital media

The data show is one of the ICT tools. 99% of the teachers interviewed stated that in their elementary school, there is only one data-show and 1% of the teachers who participated stated that this tool no longer exists in their school (Figure 5).

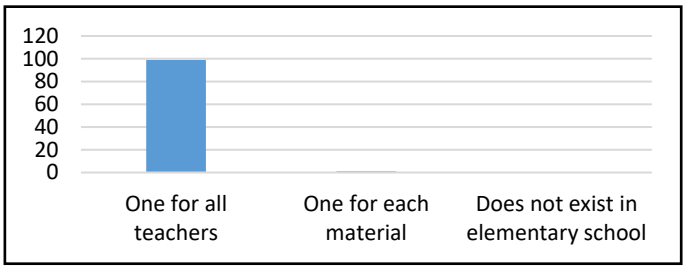

Fig. 5. The existence of DATA-SHOW

Integration of ICTE. These results show that most teachers integrate ICTE into a few courses, with 97% using ICTE, and only 3% not using ICTE in their courses (Figure 6).

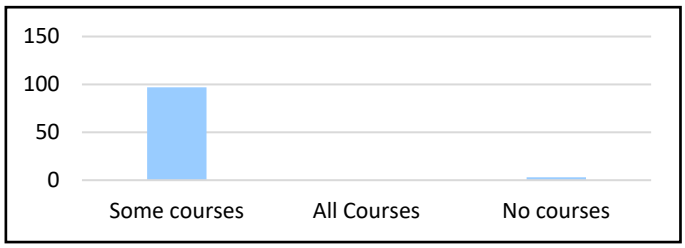

Fig. 6. Integration of ICTE into the courses

Discipline that requires the integration of ICT. 90% of teachers say that science is the discipline that requires the most integration, 80% say that French commands the integration of ICT, and 60% use ICT in mathematics (Figure 7). Most teachers consider ICTE an aid to teaching. As part of their job, they make use of a variety of technological resources [33].

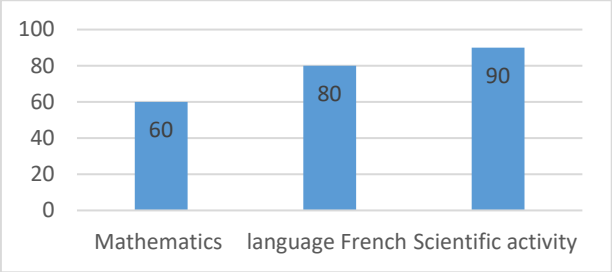

Fig. 7. Discipline requiring the use of ICTE in %

ICT provides chances for teachers to experiment with novel activities that benefit pupils. New tools enable innovative teaching methods that include concept visualization and interactive knowledge-based activities. However, incorporating ICT, as a pedagogical tool needs more than simply replacing old tools with new ones, it necessitates a full process of restructuring education and organizational structures. Distance technologies are critical for connecting learners and teachers, enhancing understanding, and facilitating travel in training and education. While the use of ICT for educational purposes has several benefits, it is not without obstacles.

Integration of ICTE in the discipline of scientific activity. The science awareness discipline consists of two components. The first part deals with the natural sciences (their vital functions and their interaction with the environment, human health and its interaction with the environment, the life cycle of organisms, reproduction and heredity). The second part deals with the natural sciences (force and motion, classification of materials and their properties, forms and modes of energy transfer). Both parts are rich in photographs and simulations for the reader's pleasure. According to the findings, all of the teachers in the life science part utilize ICTE for their course, and 70 out the 80 teachers in the physical science section use ICTE.

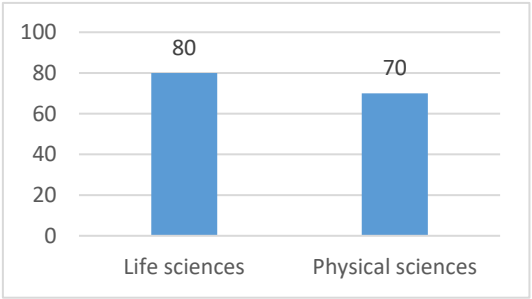

Fig. 8. Use of ICTE in scientific activity

Integration of ICTE into the discipline of mathematics. According to the curriculum of primary schools, which was published on July 2021, on the website of the Ministry of National Education, Preschool, and Sports, the discipline of mathematics is divided into 3 main fields: the field of geometry, the field of measurement, and the field of numbers and calculation. The incorporation of ICT in the

three fields of mathematics is significant because it simplifies the explanation of the relevant part [6] [34]. When teaching mathematics in the primary schools, we discover that 80 teachers use the ICTE in the field of measurement, 70 in the field of numbers and calculation, and 60 in geometry. Students' cognitive predispositions for success in STEM areas and differences in solving issues are explored through a mathematics learning computer game design of STEM school programs, the use of computer games for learning, and educational policies that encourage equity as well as excellence in STEM subjects [35].

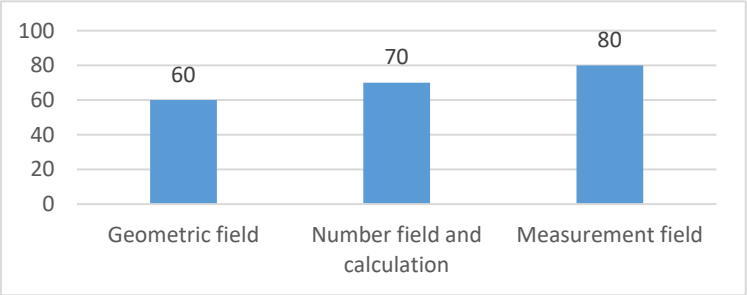

Fig. 9. Use of ICTE in the discipline of mathematics

4.4 Teacher's attitudes towards ICTE

Teaching with digital. From this question, we can see the importance of ICTE, as the majority of teachers interviewed confirm that teaching with digital technology facilitates the task of the teacher, saves time for explanation, and attracts the attention of students (Figure 10).

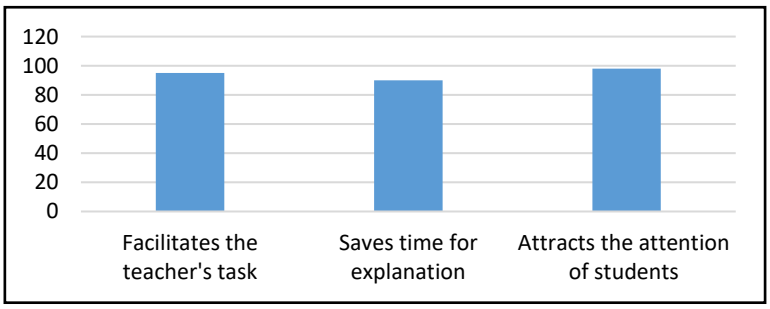

Fig. 10. Teaching with digital in %

ICTE is a solution to make students more attentive, serious, and interested in acquiring scientific and technological information so that they can fully participate in the learning process. Results also indicate that this lack of skills in the integration of ICTE is mainly due to the quantitative and qualitative insufficiency of teacher training in this area. The successful integration of these technologies in the classroom depends on the degree of technical, pedagogical, methodological, and didactic skills acquired

by the teacher [36]. However, many studies have highlighted the role of ICTE in improving student motivation and attention. Others show that the integration of new technologies at home and in the classroom would help students achieve better results in national tests, especially in mathematics [33].

Advantages of using ICTE. The majority of teachers have become aware of the importance of ICTE in an educational environment and have started to use it in their daily tasks thanks to the knowledge they acquired during training. In a teaching-learning situation, the teacher still plays a dominant role and remains the initiator of ICTE integration, for example, by distributing his or her lectures in digital format to students [37]. ICT uses many visual representations, which, on the one hand, attracts the attention of students and, on the other hand, allows a faster and more efficient memorization of knowledge (Figure 11).

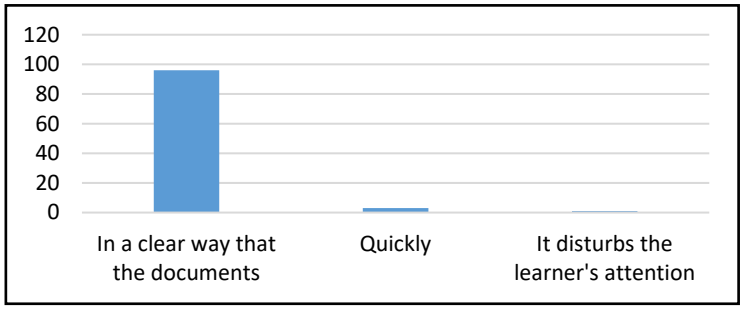

Fig. 11. Advantages of using ICTE in %

The analysis of the results obtained has thus allowed the following points to emerge:

- ICTE helps learners understand concepts more clearly than documents (96%).
- ICT helps the learner understand a concept quickly (3%).
- ICT disturb the learner's attention (1%).

5 Discussion

According to the findings, the most significant benefit of ICTE is the way it helps learners to concretize what they know through simulations that explain a phenomenon or a concept as it is in reality; in this scenario, ICTE creates a link among school and training. Integrating ICT into the teaching and learning process needs rigor, a diverse set of methodologies, and, most importantly, a plan for establishing pedagogical practices [38]. The vast majority of primary school teachers incorporate ICTE into their STEM course presentations; they employ images and videos in their own courses, as several studies indicate that images and videos are very appealing to students in primary schools because they are one of the most prevalent didactic means in STEM teaching and learning and that a visual medium can appeal to the child's imagination. Images may be utilized on a regular basis to educate and strengthen students' memory; in the long run, teachers can deliver difficult explanations on a regular basis and assure their

correctness; teachers might make lessons more interesting and assignments more pleasant, which may boost students' attendance and attention [39] [40].

Because primary school pupils are particularly interested in everything visual and dynamic, ICTE employs a variety of visual representations that, on the one hand, capture students' attention while also allowing for faster and more effective knowledge memorization [41]. ICTE integration in school fosters collaboration and teamwork while also developing metacognition. ICTE integration is common in STEM at all school levels. The majority of teachers polled agree that using digital technology to teach facilitates the teacher's role, provides a good explanation to the learner, saves time for explanations, and captures students' interest [38].ICTE employs a variety of visual representations to pique the learner's interest and attention, allowing them to memorize information rapidly and effectively. However, this strategy must be utilized with caution so that children do not become passive. Technological tools have become so vital in our daily lives that it would be unusual not to see them increasingly used in classroom instruction [32]. ICTE is critical for STEM education, especially in this digital age. They improve teaching and learning opportunities in STEM education by incorporating images and videos as teaching aids [14].The integration of ICTE as a pedagogical tool cannot be reduced to just replacing old tools with new ones but must be viewed as a broader global process of organizational training reconfiguration. They would boost motivation, personalize learning, take cognitive profiles into account, and render learning more enjoyable, stimulating, and interactive. For teachers, digital tools also enhance learner autonomy, and recognizing the job done is a significant benefit. [42] [43].

6 Conclusion

The findings of this study illustrate the crucial role of technology in primary schools STEM education in Morocco. The primary schools is an important time to teach learners fundamental technological principles. Because of its success in motivating learners, the majority of teachers in this survey supported the integration of ICTE into science and mathematics teaching. Learners grow more engaged and autonomous as ICT is used, and they take a greater role in the individual and group production of the lessons presented. Although they utilize personal computers, a great deal of teachers in elementary schools support the integration of ICT in STEM education due to the importance and effectiveness they place on it. Teachers used ICTE in science more than mathematics since the science curriculum includes explanatory visuals in each primary school level's courses. The use of ICT is viewed as engaging learners and empowering them to be active and self-directed in their learning. According to the findings of the study, investment in computer resources and continued teacher training are required to increase ICTE integration in primary schools. As technology advances around the world, it is critical to equip students to accept responsibility for adjusting to such changes. As a result, it is critical to select appropriate digital applications to supplement traditional paper-based programs. The reality is that comprehensive educational progress is impossible without advances in technology.

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