**INTERNATIONAL JOURNAL OF SCIENCE DIDACTICS AND EDUCATIONAL ENGINEERING (IJSDEE)**
Journal Homepage: https://IJSDEE.com
**Research Article**

| Volume 1 | Issue 1 | October-December (2023) | ISSN: 3009-5239 | Page: 148 - 157 |
|---|---|---|---|---|

# LIFE AND EARTH SCIENCE TEACHERS' DIGITAL SKILLS AND CLASSROOM TEACHING PRACTICES

*Abdelkader OUHTIT [1,2], Rajae. ZERHANE [1], Rachid JANATI-IDRISSI [1]*
*1 :ERIPDS[1], École Normale Supérieure, Abdelmalek ESSAADI University, Tetouan, Morocco*
*2 :Académie régionale de l'éducation et de formation Tanger – Tétouan - Al Hoceima*

ARTICLEINFO

*Keywords*:
Digital skills, Learning, Teaching, Teaching practices, ICT.

ABSTRACT

During the recent reforms of its educational system, Morocco has continually undertaken actions to promote the integration of ICT (Information and Communication Technology) in teaching. However, this integration faces several challenges. In this context, the 2021 annual report from the Higher Council of Education in Morocco revealed that 64.6% of teachers were dissatisfied with their experience of distance teaching during the time of Covid-19, when ICT was heavily utilized. To explain this observation, we attribute it to the level of mastery of digital skills among teachers, which we assume is not sufficiently developed to enable successful integration of ICT into their teaching practices. With this perspective, we conducted two studies on the digital skills of life and earth science teachers. The results obtained reveal a modest level of digital skills among the teachers in our sample.

## INTRODUCTION

All players in the Moroccan education system are aware of the opportunities offered by the integration of ICT to improve teaching and learning, since ICT can support active pedagogy by encouraging exchanges between learners, research and consultation of documents, and the construction of knowledge. Although the focus is more on learning than teaching, the integration of ICT by Life and Earth Science teachers is not satisfactory. Indeed, the results of some studies have shown that the rate of integration of ICT into teaching practices remains very low (Tarichen et al., 2017). In fact, it's not enough to equip schools with digital resources for uses to develop around these tools (Maouni et al., 2014). Teaching with technology becomes even more challenging when considering the challenges that new technologies pose to teachers (Koehler & Mishra, 2008).

With the advent of the Covid-19 pandemic and with the aim of ensuring pedagogical continuity while preserving the health of individuals (learners, teachers and administrative staff), the Ministry of National Education took a range of measures including the introduction of distance learning, alternate teaching, the establishment of educational platforms (Telmidtice and Taalimtice), and the broadcasting of lessons on national TV channels. Although both teachers and learners have become involved in distance learning by exploiting ICT, the results of an evaluation of teaching at the time of Covid-19 showed that only 35.4% of teachers were

[1] *ERIPDS : Equipe de recherche en ingénierie et didactique des sciences*
*Corresponding author : Abdelkader.ouhtit@etu.uae.ac.ma*

satisfied with their experience of distance learning (Higher Education Council, 2021). These results led us to wonder whether this dissatisfaction might be rooted in the level of digital skills among Life and Earth Science teachers.

The integration of ICT in teaching (whether (whether in-person or remote) requires the development of a set of technological skills, also known as digital skills (Papi, 2012). With this in mind, the objective of this work is to assess the digital skills of life and earth sciences teachers by comparing their own perceptions of their digital skills with their teaching practices. This is to test our hypothesis linking the problem of ICT integration in life and earth sciences to the lack of development of life and earth science teachers' digital skills.

## 1. THEORETICAL FRAMEWORK

Technological (digital) development has changed the way people and organizations interact, and these technological advances have already, and will continue to have, a professional, social and cultural influence. As Marshall Macluhan put it, "We shape our tools, and they, in turn, shape us" (Plante, 2015). Education is no exception to this digital omnipresence, and is being transformed. Indeed, since the advent of computing and the "digital" technologies that flow from it, and in recognition of the role that integrating ICT into education can play in reducing inequalities at school and delivering equitable, quality education for all learners, countries around the world are seeing profound changes in their education systems to integrate digital into school curricula as well as teaching practices.

### 1.1. ICT in education: between use and integration

We often associate the two terms "use" and "integrate" with ICT. However, using ICT in teaching-learning situations does not mean that the teacher has integrated it into the process. Indeed, using ICT implies a basic incorporation of ICT into the teaching act, such as using a video projector to present slides during a lesson. On the other hand, integrating ICT goes beyond the simple use of ICT to turn them into pedagogical tools for research, collaboration, sharing and evaluation. For Mastalfi (2016), integrating ICT must be done in association with an appropriate pedagogical approach (Mastafi, 2016). It is in this sense that M.Lebrun argues that to speak of the efficiency of ICT requires reference to the methods in which these tools will take their place, and further still to the educational objectives that underpin them (Lebrun.2007). Indeed, according to Balanskat, the impact of ICTs depends to a large extent on how they are used: learners' performance is enhanced when teachers use them for pedagogical purposes and not simply as a means of modernizing their teaching (Balanskat et al., 2006).

### 1.2. SAMR, a model for assessing ICT integration

This model provides a better understanding of the steps teachers need to take to successfully integrate digital tools (Puentedura, 2010). It's made up of four stages - Substitution, Augmentation, Modification and Redefinition (SAMR). Allowing, within the teaching and learning context, the description and positioning of the level of technology integration by teachers.

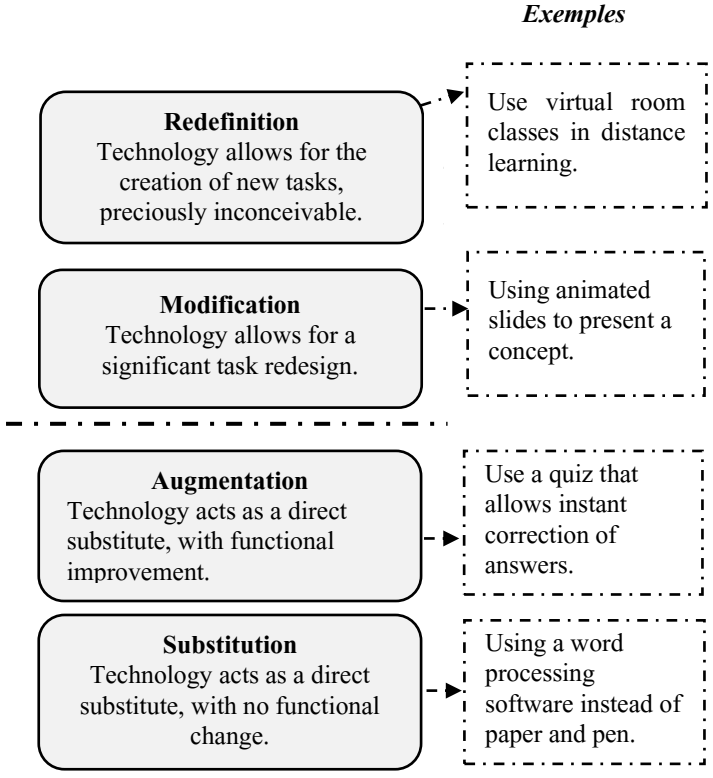


*Figure 1. The SAMR model (Puentedura 2010)*

### 1.3. Digital skills

The notion of competence was initially used in the socio-economic field to manage companies' human capital. In this field, the word competence is synonymous with performance and efficiency, which are determining factors in the career advancement of employees. The encouraging results obtained in the economic field following the adoption of the competency-based approach have encouraged other sectors to adopt it too. Consequently, that competency has found itself propelled to the heart of educational reforms all over the world, including Morocco.

With the advent of ICT in the classroom, teachers are obliged to acquire digital (technological) skills, enabling them to integrate digital tools and resources into their teaching practices. These technological skills are strongly proclaimed by Moroccan curricula, to designate a set of skills enabling the use of new technologies.

Throughout our research, we'll be adopting Le Boterf's definition, which we consider more relevant in the context of ICT integration: "To be competent is to be capable of acting and succeeding competently in a work situation (activity to be carried out, event to be faced, problem to be solved, project to be carried out...). It means implementing a relevant professional practice while mobilizing an appropriate combination of resources (knowledge, know-how, behaviors, modes of reasoning, etc.). We are referring here to the field of action" (Boterf, 2008). Indeed, it's not enough to possess "resources", you also need to know how to use them wisely in particular contexts. From this perspective, competence is treated as a process, not as a sum of resources. In the same sense, digital competencies have been defined as the ability to use ICT effectively and autonomously (Brotcorne & Valenduc, 2008). In other words, they represent an individual's capacity to employ and combine knowledge (knowing), skills (know-how), and attitudes (know-being) to use information and communication technologies, whether new or existing, to:

- Analyze, select and critically evaluate digital information;

- Solve problems;

- Develop a collaborative knowledge base while engaging in organizational practices (Bernier et al., 2016).

During our study we referred to the digital skills reference framework (DigCompEdu version 2.1), implemented by the European Union in 2017, and was adopted by the majority of European countries[1]. This reference framework describes 22 digital skills (Redecker, 2017), wich can be classified into 6 domains based on the objective of teachers' use of digital technologies.

***Table 1. Ranking of digital skills according to the purpose of the teacher's use of technology.***

| Domain | The purpose of using digital technologies |
|---|---|
| **Professional engagement** | Use digital technologies for communication, collaboration and professional development. |
| **Digital resources** | Research, create and share digital resources. |
| **Teaching and learning** | Manage and orchestrate the use of digital technologies in teaching and learning. |
| **Assessment** | Use digital technologies and strategies to improve assessment. |
| **Learner empowerment** | Use digital technologies to enhance inclusion, personalization and active engagement of learners. |

| | |
|---|---|
| **Facilitating learners' digital competence** | Enable learners to use digital technologies creatively and responsibly for information, communication, content creation, well-being and problem-solving. |

[1]Bulgaria, Denmark, Germany, Spain, France, Italy, Latvia, Luxembourg, Hungary, Netherlands, Poland, Romania, Slovenia, Slovakia, United Kingdom, Montenegro, North Macedonia, and Norway.

With a view of assessing the digital skills of life and earth sciences teachers, we carried out two surveys combining both quantitative and qualitative data to better understand our subject of study.

### 2.1. Teachers' perceptions of their digital skills

With the aim of identifying teachers' perceptions of their digital skills, we conducted a survey an online questionnaire. Our sample consisted of 121 life and earth sciences teachers.

***Table 2. Distribution of surveyed teachers according to gender and teaching experience.***

| | Genre | | Teaching experience (in years) | | |
|---|---|---|---|---|---|
| | ♀ | ♂ | [0 – 5] | ] 5 – 10] | 10 < |
| % | 54.3 | 45.7 | 34.3 | 31.4 | 34.3 |

The sample is represented by 121 life and earth sciences teachers, with 54.3% female and 45.7% male representation. These teachers work in public schools (Urban and Rural) under the direction of Tetouan.

The survey questionnaire was designed based on the European framework for educators' digital competence, DigCompEdu (Redecker, 2017). This choice is justified by the fact that this European framework is built upon UNESCO's Digital Competence Reference Framework, which the Moroccan Ministry of National Education utilized as the foundation for its in-service ICT training program (GENIE program) for teachers (BENALI et al., 2021).

| | ♀ | ♂ | [0 – 5] | ] 5 – 10] | 10 < |
|---|---|---|---|---|---|
| % | 71 | 29 | 22.5 | 32.5 | 45 |

### 2.2. Teaching practices and ICT

With a view to comparing teachers' perceptions of their digital skills with their teaching practices, we organized classroom visits to a sample of 31 teachers from the Tetouan directorate.

***Table 3. Distribution of teachers visited in class by gender and teaching experience.***

For this survey, we developed an observation grid based on the synthetic model of pedagogical integration of digital technology for innovative practices (Drissi, 2019) and the SAMR model, which focuses on levels of ICT use/integration by teachers (Puentedura, 2010).

Thus, our observation grid has four parts:

- General data on the teaching-learning environment.
- Nature and time of use of the digital resource.
- Level of ICT use/integration according to the SAMR model.
- Role of the learner during the exploitation of the digital resource.

### 2.3. Validation and reliability of data collection tools

The questionnaire for the first survey and the observation grid were underwent peer validation. We administered the questionnaire to a test sample of 12 teachers to check the clarity and precision of the questions. As for the observation grid, we tested it in class with 6 teachers. Following the teachers'

comments, certain questions or sections of the observation grid were reformulated or deleted. Subsequently, both tools were submitted to our thesis supervisors (experts) for a final validation.

## 3. RESULTS

### 3.1. SVT teachers' perceptions of their digital skills

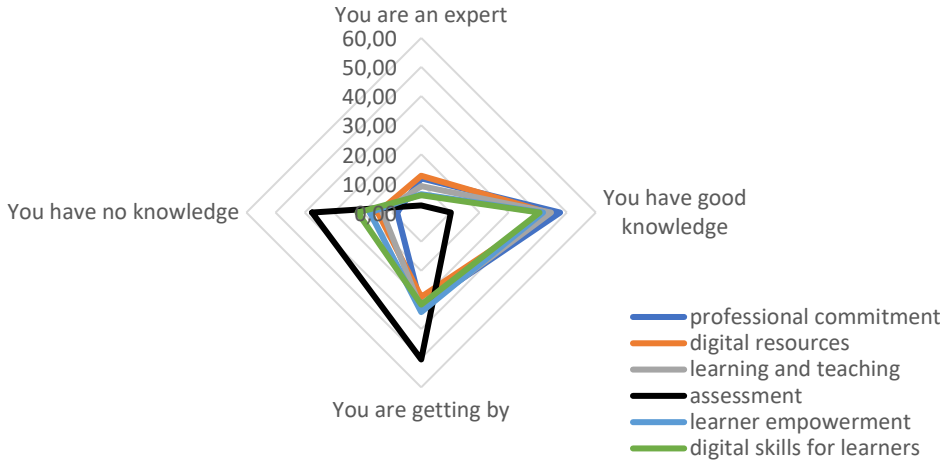


*Figure 2. The distribution of average scores obtained for each domain of digital competence.*

In terms of overall trend, we can say that 50% of the respondents feel they have a good knowledge of using ICT in connection with five domains of digital competences: professional commitment, digital resources, learning and teaching, learner empowerment and developing learners' digital skills. The least developed domain is that linked to the use of ICT for the assessment of learning. In any case, it is rare for a teacher to consider himself or herself an expert in mastering of digital skills.

### 3.2. Teacher Training in ICT and Its Context

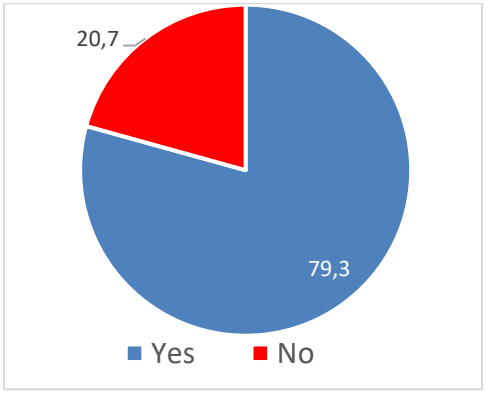


*Figure 3. An overview of the state of teachers ICT training.*

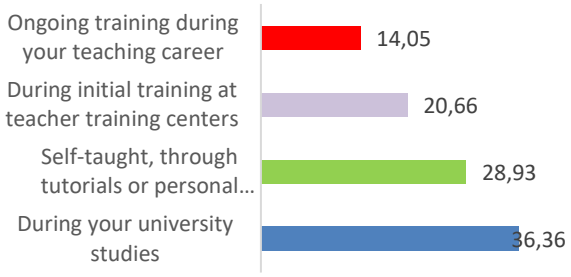


*Figure 4. The context of ICT teacher training.*

The figure 3 shows that 20.7% of teachers have never taken advantage of ICT training, and of those who have, only 14% did so as part of continuous training, mainly during university studies (36.36%), as self-taught (28.93%) or during initial training at teacher training centers (20.66%).

### 3.3. Teachers' level of satisfaction with their digital skills

Regarding the level of teachers' satisfaction with their digital skills, our sample is divided into three groups of almost equal proportion. Thus, 1/3 of the surveyed teachers were not satisfied with their digital skills, while the remaining two-thirds were either

satisfied or fairly satisfied.

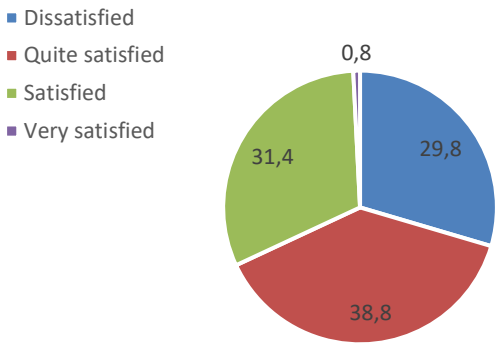


*Figure 5. Level of teacher satisfaction*

### 3.4. The impact of distance ICT training on digital skills

The results in figure 6 indicate that 70.2% of surveyed teachers believe that distance training in ICT would have a significant or major impact on improving their digital skills. In contrast, 25.6% of our sample felt that this kind of training would have a low impact, or no impact at all. For 4.1% of the same sample, they considering it to have no impact at all.

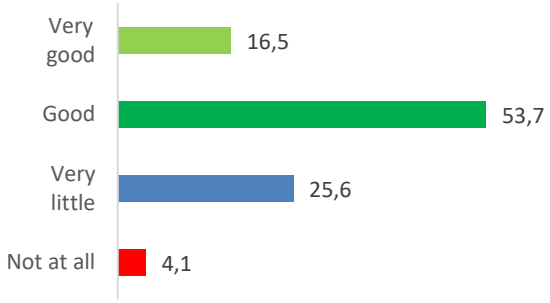


*Figure 6. impact of distance ICT training on digital skills)*

### 3.5. Teaching practices and digital skills

According to the results in figure 7 and figure 8, a significant percentage of the teachers visited in class (29.03%) do not use ICT in their teaching practices. For teachers who have utilized ICT, the most commonly used technological tools are the computer and the data-show.

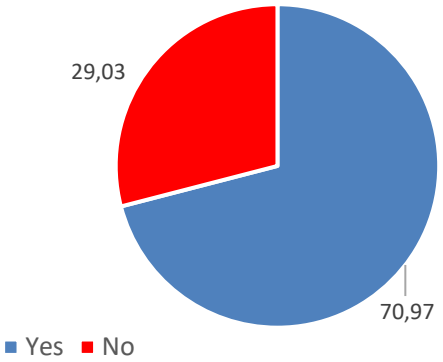


*Figure 7: Teachers' use of ICT*

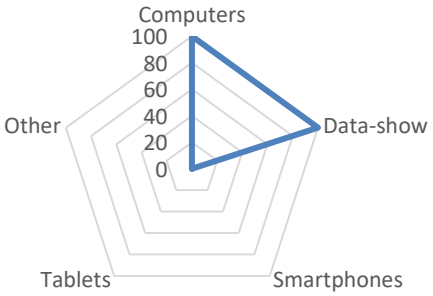


*Figure 8. Digital equipment used by the teachers*

According to the results in figure 7 and figure 8, a significant percentage of the teachers visited in class (29.03%) do not use ICT in their teaching practices. For teachers who have utilized ICT, the most commonly used technological tools are the computer and the data-show.

### 3.6. The use of ICT by teachers and the role of the learner

Referring to the SAMR model, the results displayed in Figure 9 indicate that 92% of the teachers in our sample use ICT to perform the same task. For 8% of our sample, ICT serves for improvement.

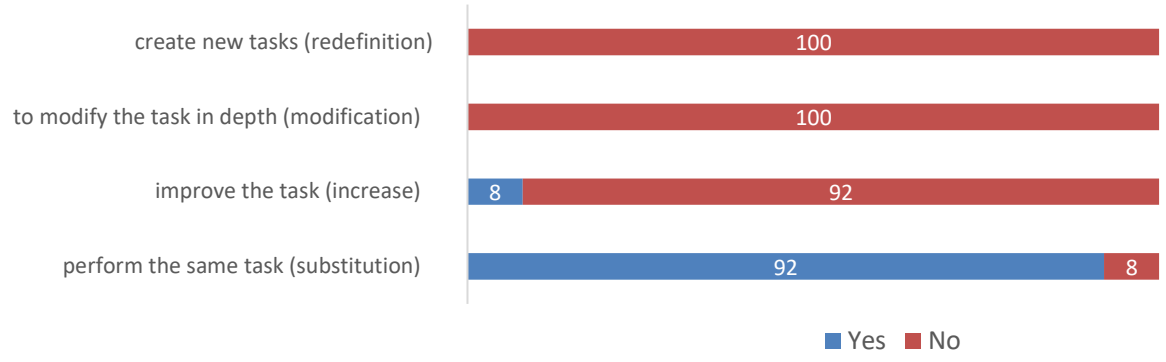


*Figure 9. The level of use of ICT by teachers*

In relation to the learner's role when using ICT, the diagram in figure 10 reveals that in 92.3% of cases, the learner passively receives the information and in 7.7% of cases, they interact with the digital resource. The learners manipulate the digital resource in only 4% of classroom visits conducted.

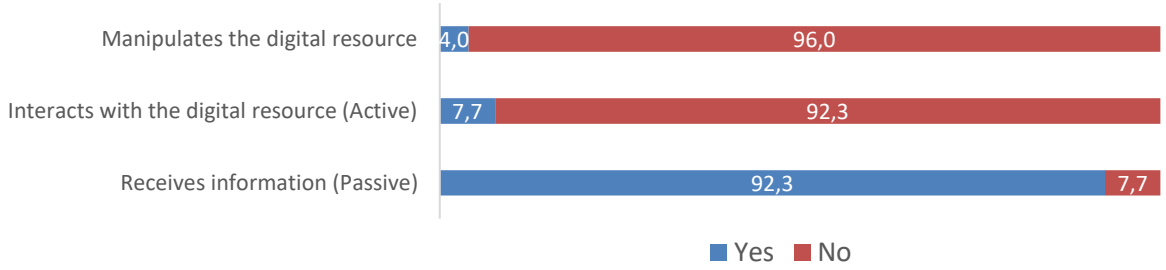


*Figure 10. The learner's role in using ICT.*

## 4. DISCUSSIONS

### 4.1. Life and earth sciences teachers' perceptions of their digital skills

As mentioned earlier, the main aim of our research is to assess the digital skills of life and earth sciences teachers under the direction of Tetouan. With this in mind, teachers in our sample express a cautious self-assessment, stating that they have good knowledge, without being experts, in five domains of digital competences mentioned in the European framework for teachers' digital competences. However, when it comes to the domain of assessment, participants consider themselves limited in using ICT to improve their practices related to learning assessments. Indeed, two-thirds of this sample express satisfaction or relative satisfaction with their level of digital skills. In the same sens, the results of a national survey on pedagogical continuity and distance learning during the lockdown period showed that two out of three teachers surveyed were generally satisfied with their distance learning, characterized by massive use of ICT (Benkaraache Taoufik, 2020). Furthermore, a study on the integration of ICT in teaching showed that for a heterogeneous sample of teachers working in schools (primary, middle and high schools) not suffering from a shortage of ICT infrastructure, that 86.2% of the surveyed teachers stated they do not have sufficient or any skills to integrate ICT into their teaching practices (Mastafi et al., 2018). These results support our initial hypothesis that the limited integration of ICT in the

teaching of life and earth sciences is related to teachers' digital skills.

### 4.2. Teaching practices reveal a modest level of digital skills

Teachers of life and earth sciences visited use ICT to replace an existing non-digital tool in order to perform the same task as before. Specifically, ICT is utilized more as information tools rather than learning tools, reducing learning to the transmission of information, where the learner plays the role of a passive receiver. This situation worsens when teachers choose to use ICT to project summaries of their courses.

In short, it appears that even though the laboratories in the schools visited have digital equipment and resources, a significant percentage of teachers (29.03%) do not incorporate ICT in their teaching practices. This finding aligns with the results of a study on ICT integration in education, showing that providing schools with digital resources alone does not necessarily lead to their effective use (Maouni et al., 2014). For the 70.97% of teachers who did use ICT during our observation visits, it was more a question of use than integration. For pedagogical uses of ICT, teachers mainly use word processing and presentation software such as Word, PDF and PowerPoint; none of the teachers visited used simulations or EXAO. The use of ICT is not scripted, and takes place mainly in structuring situations during the lesson. Indeed, the use of ICT is reduced to a simple conversion of paper lessons to digital lessons in the form of Word and PDF and their presentation by PowerPoint. While these tools are satisfactory in terms of ergonomics, adaptability to school curricula and ease of access, they are far from enabling the traceability of learning activities and the development of learner autonomy. To explain this reluctance to use and integrate ICT, life and earth science teachers tend to limit the use and integration of ICT for several reasons:

Firstly, the presence of defective digital equipment. Indeed, the equipment most in demand by teachers is the computer accompanied by the data-show. The latter is characterized by the presence of a bulb with a limited lifespan, and it is rare for the school to replace it once the lifespan has run out, given its price.

Secondly, the laboratories in the schools visited are equipped with desktop computers, and the teacher sometimes refuses to use them, given that the majority of life and earth sciences lessons take place in rooms far from the laboratory.

The third reason for this reluctance is teachers' lack of training in the field of information technology, since new technologies are in themselves a challenge for teachers wishing to integrate them into their teaching practices (Koehler & Mishra, 2008).

A fourth factor to explain this resistance is put forward by Bibeau: according to him, teachers feel disrupted by the changes brought about by educational reforms, which is why they prefer to maintain their habits of teaching practice (Bibeau, 2007).

Nevertheless, and in relation to the subject of our study, it becomes evident that teachers' reluctance to integrate ICT into their teaching practices is largely due to their limited digital skills, which are not sufficiently developed to ensure successful integration of ICT. These digital skills enable them to use ICT as a substitute for non-digital material, but without a profound modification of their teaching practices.

### 4.3. Distance continuing education for digital skills

Faced with the upheavals in school curricula and teaching approaches, it has become essential for teachers to update their knowledge and professional skills, hence the importance of continuing training (Perrenoud, 1994). With this in mind, Morocco launched the GENIE program in 2006/2013, aimed at training the Ministry's teaching staff in information and communication technology. According to the 2013 annual report published by the ANRT[2] agency, the GENIE program has trained 70% of Ministry of Education's teaching staff, but the results of our survey showed that only 14% of our sample had received in-service training in ICT. This discrepancy between the percentage mentioned in the report and that of our survey can be explained by two factors: the first is that the GENIE program



[2]The National Telecommunications Regulatory Agency is the public institution responsible for the regulation and oversight of the telecommunications sector in the Kingdom of Morocco.

targeted all Ministry executives (primary and secondary school teachers, administrative executives and inspectors), whereas our study targeted teachers only; the second factor is that our sample includes only 43% of teachers whose seniority exceeds 10 years, and therefore could have benefited from the GENIE training which ended in 2013. This situation explains why a large proportion of our sample agrees that distance training can improve their digital skills. In the same vein, the results of a survey concerning distance training on ICT showed that this training helped 67.8% of teachers to integrate ICT into the classroom (Mahdi et al., 2018).

The teachers in our sample expressed various needs in terms of ongoing ICT training, indicating disparities in their digital skills. The topics that received more attention were digital content creation, ICT integration and pedagogical scripting. In response to these difficulties, we are proposing to set up a distance training course aimed at developing teachers' digital skills by integrating ICT into this in-service training. In line with the proposed solution, the results of a study on online in-service training have shown that teachers are highly motivated to benefit from distance in-service training, which gives teachers great flexibility in terms of time and space (Chekour et al., 2014), in fact a teacher can benefit from online in-service training according to his or her needs regardless of spatio-temporal dimensions.

**CONCLUSION**

This research has revealed that the level of mastery of digital skills among the life and earth sciences teachers surveyed is far from homogeneous. Thus, teachers' perceptions of their digital skills are at odds with their teaching practices. Indeed, life and earth science teachers often have a limited vision of ICT, seeing it primarily as a tool for presenting information, rather than as an interactive and stimulating pedagogical tool for learners. They often lack planning in the integration of ICT, failing to develop pedagogical scenarios that show how, when and why to use digital resources in their classes.

In short, life and earth science teachers are aware of the possibilities offered by the integration of ICT to improve their teaching. However, the observation of their teaching practices in the classroom revealed that their digital skills are basic, offering them the possibility of using ICT as a substitute for non-digital material, without enabling them to significantly improve their pedagogical act. In reality, it's the teacher who uses ICT to facilitate the teaching task (diversity of teaching aids, substitution of the blackboard by the data-show), without considering learning, as the learner in this situation is often a passive recipient of information without the opportunity to use or interact with ICT.

In the end, distance training seems to be a suitable mechanism for providing continuing training aimed at developing teachers' digital skills, by limiting the cost of training, benefiting a larger number of teachers, and there's nothing better in training than getting involved hands-on; in our case, it's about developing the digital skills of life and earth science teachers by allowing them to use these skills throughout the distance training program.

**REFERENCES**

Balanskat, A., Blamire, R., & Kefala, S. (2006). The ICT impact report. European Schoolnet, 1, 1-71.

BENALI, M., Mohammed, B., & ZEROUALI, A. (2021). Mise en œuvre du référentiel UNESCO de compétences TIC pour les enseignants marocains.

Benkaraache Taoufik, D. A. (2020). Continuité pédagogique et enseignement à distance en période de confinement: Perception et satisfaction des acteurs.

Bernier, A., Bourdeau, S., Dubuc, L., & Vieru, D. (2016). Compétences numériques: des compétences nécessaires pour soutenir le passage au numérique des PME.

Boterf, G. L. (2008). Repenser la compétence. Pour dépasser les idées reçues: 15 propositions ((E.-É. d'Organisation, Ed. 2ème éd ed., Vol. 3).

Bibeau, R. (2007). La «recette» pour l'intégration des TIC en éducation. Montréal, février.

Brotcorne, P., & Valenduc, G. (2008). Construction des compétences numériques et réduction des inégalités. Une exploration de la fracture numérique au second degré. Bruxelles: SPP Intégration sociale.

Chekour, M., Laafou, M., Janati-Idrissi, R., & Mahdi, K. (2014). La valeur ajoutée de la formation continue en ligne des enseignants de sciences physiques dans le simulateur PSPICE:

Lebrun, M. (2007). Théories et méthodes pédagogiques pour enseigner et apprendre: quelle place pour les TIC dans l'éducation? De Boeck Supérieur.

Mahdi, K., Laafou, M., & Janati-Idrissi, R. (2018). L'impact des formations continues à distance aux enseignants des sciences physiques dans des logiciels de simulation informatique.

Maouni, A., Mimet, A., Khaddor, M., Madrane, M., & Moumene, M. (2014). L'intégration des TIC dans l'enseignement delife and earth sciences au Maroc: réalité et attentes. In: RADISMA.

Mastafi, M., Mabrour, A., & Balle, F. (2018). Intégration des TIC dans l'enseignement: quels déterminants de résistance au changement chez les enseignants? Revue Scientifique internationale de l'éducation et de la Formation/RSIEF VOL, 3(6).

Mastafi, M. (2016). Définitions des TIC (E) et acception. Penser les TIC dans les universités du Maghreb, L'Harmattan.

Mishra, P., & Koehler, M. J. (2008). Introducing technological pedagogical content knowledge. annual meeting of the American Educational Research Association.

Papi, C. (2012). Des référentiels à la validation des compétences numériques: questionnements et dispositifs. Questions vives. Recherches en éducation, 7(17), 11-17.

Perrenoud, P. (1994). La formation continue comme vecteur de professionnalisation du métier d'enseignant. Faculté de psychologie et de sciences de l'éducation: Service de la ….

Plante, P. (2015). La «pédagogie hacker»: un modèle de démocratisation de la technologie. Le Tableau: Échange de bonnes pratiques entre enseignants de niveau universitaire, 4(1), 1-2.

Puentedura, R. (2010). SAMR and TPCK: Intro to advanced pracTIC. In.

Redecker, C. (2017). European framework for the digital competence of educators: DigCompEdu.

Tarichen, T., Zerhane, R., & Janati-Idrissi, R. (2017). Utilisation des TIC par les enseignants deslife and earth sciences du cycle secondaire dans l'enseignement de l'immunologie. EpiNet, 195.

**Web pages**

Conseil Supérieur de l'éducation, d. l. F. e. d. l. R. S. (2021). ENSEIGNEMENT AU TEMPS DE Covid AU MAROC. https://www.unicef.org/morocco/ consulte le 23.02.2022

Drissi, M. M. h. (2019). Schéma directeur du développement des ressources pédagogiques numériques. Séminaire national d'Agadir 15-16 Juillet 2019. http://omafor.technoeducative.com/publications.html consulte le 05.06.2022