Changes of the teachers' motivational attitudes towards the integration of the information and communication technologies in the Tunisian education

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Abstract

In fact, although the integration of the information and communication technologies (ICTs) in education has been on the political agendas of education for several years, the slow pace of this integration is often observed. However, few studies have evaluated the evolution of the technology integration through an empirically rooted approach. Therefore, based on the data collection carried out between 2017 and 2020 on a population of different college and secondary school teachers, this research offers an inventory of the evolution of the teachers' attitudes in several disciplines, such as (languages, physics, history, geography ...) towards the integration of ICTs in the region of Sfax. For this reason, different motivational variables associated with the integration of ICTs were analyzed. Our results indicate that the teachers' feeling of competence as well as the attractiveness and the perceived value of the ICTs integration have strongly increased in 4 years, but to a lesser extent. Moreover, our analysis highlights the variations in several independent variables. The results of this analysis showed that generational as well as gender differences tend to decrease.

Keywords: Teachers' motivational Skills; Ownership ICT; Tunisian Teachers; Tunisian education system.

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1. Introduction

Moreover, the information and communication technologies (ICTs) are increasingly being used in teaching and exploited in language laboratories by teachers seeking to improve the way they teach a language. In this context, it seems essential to focus on this type of medium to review the way in which the necessary skills are transmitted to students in Tunisia. Therefore, it is necessary to focus, on the one hand, on the skills for the use of new technologies in teaching and, on the other hand, on their impact as a means of increasing motivation among the learners in the classroom [Bouchaib, (2018); Bouyzem, (2015), Dieuzeide, (1994), Djebbari, (2013), El Mendili, (2004, 2016)].

In fact, a developed pedagogical device is set up in order to propose pedagogical activities to our students using the ICTE. For this reason, we will conduct a comprehensive field research that includes a qualitative analysis of a set of students from different high schools in the governorate of Sfax (Tunisia). Our investigation is therefore oriented towards an explanatory study through which we will underline the possible role of the ICT in the motivation and practical and oral teaching of students.

Since the first pedagogical applications in computer science in the 1990s up to the integration of personal digital assistants, such as computers, tablets or interactive whiteboards, the development of technologies for student learning has significantly evolved in recent years. In this respect, the turning point of the 2000s was characterized by a strong willingness to integrate information and communication technologies in education (ICTs), which were often included in educational policies. As a result, many hopes were placed on this integration. It was almost fifteen years ago that Tardif and Mukamurera (1999) predicted that for the first time in centuries, the ICTs had brought about "the opening up of the cellular structure of pedagogical work" (p. 16).

In fact, the introduction of ICTs in teaching should lead to a more student-centered pedagogical approach carried out essentially in the form of projects (Peck, Cuban and Kirkpatrick, 2002). The aim was then to carry out what Karsenti and Dumouchel (2010) call the "fourth level of ICTs anchoring" (p. 218), which consists in teaching ICTS to help students learn better. Since then, researchers, such as (Karsenti, Raby and Villeneuve, (2008), Tamim, Bernard, Borokhovski, Abrami and Schmid, (2011), have underlined the potential of technologies in education by showing that they can promote student learning in several ways. Moreover, some researchers, including (Hesse, 2002), have shown that technologies develop new cognitive learning strategies and new skills in learners. So for Leask and Younie, (2001) and Zurita and Nussbaum, (2004), they suggested that technologies can promote a learner-centered or constructivist approach on the part of the teachers. However, a decade after the turning of the years two thousand, one observation was regularly made on both sides, namely that the integration of ICTs in education has fallen short of initial expectations. On the other hand, few studies have focused on the evolution of this integration in the medium term based on empirical data.

In this context, this research focuses on a larger project, which examines the evolution of the teachers' motivational attitudes towards the integration of ICTs in teaching. In fact, our approach proposes to compare these attitudes measured through a quantitative questionnaire among the same population of teachers in Sfax (Tunisia) between 2018 and 2020, which enabled us to formulate findings on an empirical basis about the evolution of the teachers' attitudes towards the integration of technologies in education. Moreover, this study focuses on training through the integration of ICTs in education, which have been provided since 2010 to the entire teaching staff. First, we will present the theoretical framework (integration of ICTs in teaching, motivation) as well as our research instrument. Then, we will develop our results regarding the evolution of the teachers' motivational attitudes towards technology. Finally, we will discuss the importance of these results, in particular, in terms of training in the integration of technologies in teaching.

Therefore, the question that this study proposes to answer is the following: How can the use of ICTs promote motivation and learning among secondary school students? In fact, this research question falls within the disciplinary field of didactics and, more precisely, in the field of teaching and learning,

which is currently undergoing a major development, and the integration of ICTs in a secondary cycle classroom.

For this reason, we will deal with the following points:

- How to integrate ICTs in classroom teaching?

- How can these new technologies be efficiently used?

- What is the impact of these new technologies on the students' motivation?

- How can motivation be at the service of the students?

In order to achieve the goal of our research and answer the original question, we have to formulate the following hypothesis, which will help us logically conduct our study: The integration of ICTs in teaching will create or increase the student's desire to learn in a way that enables him /her to develop his/her educational skills.

On the basis of the above, other hypotheses can be formulated:

-The integration of ICTs in teaching will improve the level of education by providing flexibility, accessibility, increased communication and interaction.

- The pedagogical use of ICTs in teaching increases the learners' satisfaction in comparison to traditional learning ways.

- The student's motivation, which is also achieved through the mastery of these new technologies, is built by the way these technologies are used but not by the hardware itself.

- The use of ICTs in a high school to increase the student's motivation contributes to the improvement of the results in all the academic subjects.

We believe that it is the way in which these technologies are used that would have an impact on academic success.

However, the strong evolution of technologies and the possibility of using them in classrooms have not been accompanied by a parallel growth of their integration in education (Belland, 2009). This discrepancy calls for an explanation that was sought in particular in the teachers' attitudes towards ICTs. Therefore, the low level of integrating them in teaching could be explained by the notion of habitus, or a set of provisions (Belland, 2009), which underlines the lack of enthusiasm for the integration of the ICTs in education. In this context, Liu, (2011) pointed out that there is no necessary link between conceptions and actual pedagogical practices of ICT integration in education On the other hand, some research studies, like those of Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur and Sendurur, (2012), indicated that these conceptions remain important for the teachers' understanding of the ICT integration practices in their classrooms. For example, Sahin's research (2012) showed that the perception of innovation among student teachers and the value attributed to the use of ICT are the main indicators of ICT integration in teaching.

On the other hand, the teachers' motivation to integrate ICTs in teaching has already been the subject of a great deal of research studies before that their integration was so widely inscribed on the political agendas of education (Karsenti, Savoie-Zajc and Larose, 2001). In fact, this research shows that previous experiences with ICTs, as well as the teachers' comfort with their use and their views about their pedagogical usefulness or their level of motivation, influence the degree of their integration into teaching, Mueller, Wood, Willoughby, Ross and Specht, 2008). Other authors, such as Depover and Strebelle, 1997; Rey, Pineiro and Coen, (2011; Schumacher and Coen, 2008) suggested considering the ICT integration as an innovation which is part of a process with pedagogical, technological, psychological and social components. Therefore, the degree of the teachers' motivation to integrate ICTs into their teaching is part of a complex environment, both social and psychological, but also techno-pedagogical.

Moreover, many researchers, such as Cleary, Akkari and Corti, (2008), underlined the impact of different training systems on the teachers' attitudes and motivation to integrate ICTs into their teaching. However, little research has dealt with the evolution of the teachers' motivation towards the ICTs in the medium term. Consequently, our approach brings new elements since it measures the evolution of the teachers' motivational attitudes towards the integration of the ICTs into their teaching over the last few years.

To better present this work, this article will be presented on the basis of the following points. In a second section, we will present the theoretical framework in which we approach the theoretical notions, namely, the ICTs, teaching, learning, educational sciences, competence, motivation, etc., which will be exploited later on during the analysis. Then, we will review all the theoretical notions that are related to motivation, its types and its impact on the student learning. After that, in the third section, we will present our methodology in which we talk about everything that concerns the how and why of the methodological choice, the presentation of the field and the conduct of the survey. The fourth section deals with the comparison and analysis of the collected data. Finally, the last section includes a conclusion that summarizes our findings and analyses.

2. Theoretical overview

In the teaching-learning field, a research topic is never chosen at random without looking for a solution to a real problem.

In fact, this topic is of social interest to the society as a whole, in general, and to secondary school learners and teachers, in particular. Therefore, if it turns out that the integration of ICTs in teaching fosters the student's motivation and dynamism in learning, it will be useful to sensitize teachers to a motivational pedagogy integrating these technologies in order to avoid any failure caused by demotivation. Given that today we are seeking at all levels of the educational system to improve and ensure learning success, everything must be done to ensure that more learners learn in a more meaningful and efficient way at school. In fact, it is in this sense that we see all the importance of academic motivation, which provides us with well-trained, dynamic and motivated learners ready to offer a better education to future generations.

Researchers in educational science have devoted considerable attention to motivation, and several studies have been carried out in this field to gain a better understanding of this rather complex notion. All agree that success depends on the motivation of learners.

Moreover, among the researchers who have addressed motivation, which is based on the notion of autonomy, we can mention Chesnais (1998). In fact, motivating a learner means getting him to learn to be autonomous.

With regard to motivation and academic success, Zimmermann-Asta (1995) and Lieury and Fenouillet (2019) point out that student success is linked to motivation and interest in the subject. In this context, educational guidance is important. Rolland Viau (1994), for his part, acknowledges that motivation must be taken into account by teachers in learning situations.

Although this topic is of scientific interest, the question that arises is whether the integration of the ICTs in an educational environment contributes to the creation of motivation. Moreover, several specialists state that the use of ICTs in teaching seems to be a crucial factor for the learners' success.

On the other hand, Tremblay (2000) asserts that information and communication technologies, their various fields of use and their potential for development are at the heart of the changes, issues and the challenges facing the educational world today.

In this context, we notice that, for some years now, one of the strategies of the national education system has been to equip all schools with technological means and multimedia supports.

However, this new strategy is facing many difficulties, such as the training of teachers, which represents the major obstacle, and their mistrust of the efficiency and contribution of these new

technologies to the learning process Therefore, the best way to achieve great efficiency is the teacher's know-how in well using this technological tool.

In this regard, Karsenti (2003) and Mastafi (2015, 2016) add that the impact of the ICTs on learning largely depends on how they are integrated: "We must move beyond the techno-centric discourse to better understand and analyze the impact of the ICTs on school learning and commitment, which depends primarily on the pedagogical context of their 'use' or integration in teaching.

The overall objective of this research is to examine the impact that the integration of ICTS in learning has on learner motivation and success in secondary school language classrooms. To be more specific in this study, I have set specific objectives that flow from the general objective, such as:

-Changes observed in teaching practices;

- The way in which ICTS tools are used in a course;

-The way in which learners get involved in ICTS tasks;

-The way they progress thanks to ICTs.

In addition, ICTs or ICTE (Information and Communication Technologies for Education) are digital tools and products for teaching and learning purposes. According to Poellhuber and Boulanger (2001), the term ICTs refers to "all technologies using a digital medium and serving to process information". For Karsenti (2003), Usual, Mumu and Demiraslan (2007) and Bhasin (2012), ICTs has a transversal and widespread use for teaching/learning. It is therefore important to integrate them into a pedagogical system in order to become didactic tools. In fact, it was in the 1980s that they became known in the form of "information technologies" or "communication technologies", and were most often associated with a well-defined use, notably education.

As for the term "technology", it was not until the 1960s that it began to be used in a learning and teaching framework. Moreover, the notion of learning media has evolved into a mode of use much more efficient and useful than it had been before. In other words, the ICTs, as it is now conceived has redefined the notion of learning media by using increasingly new materials.

In the 1980s, it was in the form of "information technologies" or "communication technologies" that they became known, most often associated with a well-defined use, notably education.

From the 1990s onwards, this form appears in the thesaurus of certain publications. The term has thus become a descriptor of the subject being analyzed. Since then, it is frequently found in the forms of "Information and Communication Technologies", "New Information Technologies", "New Information and Communication Technologies", etc...

The use of information and communication technologies appears to be a strategic choice for the success of learners, especially those with little training. It is in this sense that Tremblay (2000) states that "Information and communication technologies, their various fields of use and their potential for development are at the heart of the changes, transformations, issues and challenges facing the world of education today."

Moreover, several schools have adopted strategies for the development and integration of new technologies. However, these strategies often neglect the pedagogical aspect. However, the pedagogical aspect is very important if we want the integration of ICTS to be a plus in education. The integration of new technologies in teaching encourages us to rethink the pedagogical approach and to take advantage of what this type of support can provide. It is in this sense that Bourdeau, Minier and Brassard (2003) insist on the role of technology as a lever for pedagogical change. In this regard, Rocheleau et Basque (1996) assert that the integration of technologies into teaching leads to a redefinition of teaching and learning acts that lead to new forms of pedagogical intervention.

In the same vein, Poellhuber (2001) and Mishap and Koehler (2006) pointed out that the ICTs offer many interesting possibilities for teachers who wish to experiment with activities in order to make the learners more active and work together to develop their knowledge and know-how. Therefore, the

characteristics of ICTs promote the adoption of an approach that places the learner at the center of the learning process (Tardif, 1998). Moreover, they provide the pedagogical relationship with innovative means, not only for the dissemination of knowledge, but also for the exploration of the learning strategies that promote the creation of competencies (Lebrun, 2002; Marin, 2013).

On the other hand, we have to remember that language teachers often use a variety of media and distance approaches. Moreover, for many researchers, the integration of the ICT in teaching is a means of combating academic failure. Therefore, the use of the ICTs in a perspective of individualization of teaching enables some learners who have learning difficulties to compensate for their deficit to continue and eventually succeed in their studies. On the other hand,, for the most gifted students, the technological environment gives them the freedom to go further.

Moreover, despite the used multiple supports and the craze for the ICTs, their integration is much more difficult. In fact, among the obstacles to the integration of ICTs in teaching, apart from the teachers' training, which comes first, we find the teachers' low confidence in the efficiency of the ICTs in the students' teaching and learning.

As with Tardif (1998) and Lebrun (2002), teachers need to know the relevance of ICTS integration to their teaching and to better learning. I therefore feel it is important to deepen our knowledge of the real contribution of ICTs to the teaching of French as a foreign language. Moreover, according to Jefferson and Edwards (2000) and Arukaroon and Krairit (2017): "The use of ICTs in the classroom promotes learning, but this benefit depends largely on the use made of it by the teacher". It is therefore important to examine how to make good use of THE technological tools with the teacher's know-how, which could lead to an efficient approach to the teaching-learning of a foreign language in secondary schools. As for the learner, at the same time as he or she performs a disciplinary and technological learning, he or she has the opportunity to perform the appropriate learning in the context of ICTs, which contributes to the development of intellectual skills, such as critical thinking and problem solving.

In this context, Jonassen (1998) indicates that the learners cannot use these tools without reflecting on the given content. On the other hand, if they choose to use these tools, they can facilitate their learning process. Furthermore, the learners must be "competent communicators, i.e., have some level of language proficiency" (Jonassen, 1998, p. 179). Moreover, it seems important to design pedagogical devices and activities aimed at developing young children's competence in foreign-language, mainly written production in high school.

On the other hand, according to Karsenti (2003), Law, Pelgrum and Plomp (2008), the ICTs and pedagogy are both social and communicational practices. The authors add that it is rather the way the ICTs are integrated into education, which will have an impact on learning and school commitment. "It is therefore necessary to go beyond the techno-centric discourse in order to better understand and analyze the effects of the ICTs according to their pedagogical context of use because the success of the impact of the ICTs on learning and school commitment depends above all on the pedagogical context of their use or integration. Therefore, we consider that the rational integration of the information and communication technologies makes the learner responsible for learning and be very committed in subject learning.

In fact, to achieve better integration, there must be changes in the entire organizational structure of the institution. For example, in a secondary school, there is a need to adapt teachers' courses and schedules for better performance. Moreover, teachers need to take the track for renewal however, insufficient teaching hours, the need to reserve a computer room and a large number of staff are the main obstacles. In fact, the structure must also encourage teachers to use digital resources first for themselves, which is a precondition for a good appropriation.

It seems that currently, it is very important for students to learn to acquire a certain degree of autonomy. From this point of view, we can see that the gap between high school and university is immense, hence the recurring failures.

On the other hand, Albero (1998) argued that the use of the ICTs is not obvious for a learner: In fact, "Devices using technological means that help acquire a high degree of individualization and relative autonomy put a large proportion of users in difficulty. It seems that these complex devices require an active attitude, a high level of involvement and skills of a different order from those previously required [...]".

As for Nicole Bucher-Poteaux (1998), she identifies the obstacles to be overcome by stating that "The role shifting between the learner and the teacher is confusing for students because the rest of their university education continues to be in the tradition of lectures and tutorials, and because freedom is difficult to manage and responsibility can generate anxiety. Therefore, a training period necessary for self-management revolves around a first process of de-conditioning during which the student changes his representations and prejudices about learning the subjects and a second process of acquiring the know-how he needs to take charge of his learning".

In fact, the learning activity concerns the teacher, who designs it, and the learner, who carries it out. Moreover, the way in which the resources are handled is crucial, especially with the use of multimedia, which is more complex and abundant. Often, the computer tool brings back outdated practices, in this case, the used product has to fit in with the communicative approach or at least fit in through a few diversions,

Most authors agree that a new tool cannot change methodology but can at most provoke system effects: "Technological resources catalyze change in pedagogical methods because they dictate a new beginning, reconstruction of the context that suggests new ways of functioning. They can also bring about a shift from the traditional method to a more eclectic set of learning activities that give way to knowledge-building situations." (Haymore Sandholtz, Ringstaff and Owyer, 1997: 50).

There is still the problem of integrating these activities with what is done in the classroom. This is all the more difficult as it remains very limited or at least works less efficiently than expected. One of the solutions proposed for better integration is to involve teachers in the development of multimedia materials. However, this seems unlikely to be possible since the cost of producing this material cannot be met without paying the participating teachers.

The answer to this problem remains tricky because of the complexity of learning. It is even less possible to evaluate the real effectiveness of such use, given that the pedagogical and methodological environment, approach and application are not the same between a traditional course and another with ICTs: "It is impossible to compare traditional learning phenomena with those that include the use of software, because no program presents the subject as it would have been in the traditional way and its very use adds an extra dimension to learning. It is also difficult when comparing two distinct groups of students, one using the software and the other not, to find identical groups, modifying only one variable so that any changes can be attributed to the software and not to other differences between the two groups"(Louis, 1990).

It can be added that the effectiveness of computer-based teaching should not be judged in relation to a set of groups, but on its ability to improve and introduce new pedagogies in teaching. Therefore, the contribution of technology should be seen in qualitative rather than quantitative terms: "The effectiveness of computer-assisted learning cannot be seen as if this approach in itself represents a form of teaching for all learners requiring this form of teaching." (Dunkel, 1991: 24)

Nowadays, there is software that allows teachers to change educational content according to the needs of their learners. Therefore, a multimedia tool can be evaluated on its capacity to offer teachers the possibility to adapt and vary its use according to the pedagogical needs and level of the learners.

However, it should be noted that several studies looking at the impact and effectiveness of ICTs have shown favourable and positive results as in the area of language, such as:

- The improvement of learners' language skills.

- Stimulation and motivation to learn a living language.

- The impact of the tool on weaker learners.

Based on the last result, we can see and deduce that the impact of ICTs changes according to the student's level in the language: the more the student has gaps in the subject, the more he or she benefits from courseware designed for this type of learning. Conversely, the more skills the student has, the more he or she seeks greater freedom in the offered activities and demands more pedagogical structures.

3. Questionnaire on the teachers' motivation for ICT integration in teaching

In fact, the tool used in this research work aims at measuring the teachers' motivational attitudes towards ICTs in education and their evolution over time. This tool, which was initially developed in 2006 by Schumacher and Coen (2008) based on a questionnaire by Larose and Karsenti (2002), measures six teachers' motivational attitudes towards the use of ICTs in their teaching:

- The sense of competence in the technical mastery of using ICTs in education;

- The sense of competence in the pedagogical assessment of the ICTs use in teaching;

- The sense of competence in the pedagogical integration of ICTs in education;

- The attractiveness of working with ICTs in education;

- The perceived value in relation to students' learning;

- The self-orientation associated with ICTs integration in teaching.

Furthermore, several dimensions of our questionnaire are designed to assess the teachers' sense of competence in integrating the ICTs into their teaching. In fact, this feeling is a concept associated with motivation in a socio-cognitive approach, which reflects the perception of individuals about their competence to perform some tasks (Pintrich and Schunk, 2002). Consequently, this sense of competence is considered as a motivational variable since it affects not only the willingness to engage in a task but also its attractiveness (Seegers and Boekaerts, 1993).

A first dimension of our questionnaire concerns the feeling of competence in the technical mastery of ICTs in education. This dimension includes 7 items measuring the teachers' feeling of competence in the use of common software (e.g. word processing) or in other technical skills (e.g. web page creation). This dimension has a high reliability index (α=0.95).

A second dimension is about the feeling of competence in the pedagogical evaluation of ICTs in education. In fact, it takes into account the teachers' perception of their own ability to critically evaluate the pedagogical potential of ICTs in education on pedagogical and didactics levels, particularly in terms of the possibilities offered by the technologies in the context of their own professional development or to promote the students' learning. This dimension consists of four items (e.g., "I am able to critically assess the benefits and limitations of ICTs for teaching and learning", which have a high reliability index (α=0.86).

A third dimension of our questionnaire measures the feeling of competence in the pedagogical integration of ICTs in education. It takes into account the teachers' perception of their own capacities to pedagogically integrate technologies in the service of the students' learning. This dimension includes not only the integration of ICTs in the pedagogical project, but also the implementation of learning devices with ICTs in education and the remediation of technical problems in the classroom management that may be associated with it. In fact, this dimension includes six items (e.g., "I am able to integrate ICTs in my pedagogical strategies"), which have a very good reliability index (α=0.92).

The fourth dimension in our questionnaire is about the attractiveness of working with ICTs in education, which is a dimension of motivation that affects the willingness to engage in a task (Seegers and Boekaerts, 1993). In our research, this dimension, which questions the teachers' attraction to working with ICTs in the classroom, has four components (e.g., "I use ICTs in my classroom for the fun of doing assignments or projects") that have a very good reliability index (α=0.89).

Moreover, our fifth dimension represents the perceived value of the ICTs for education. In fact, the concept of perceived value makes it possible, on the one hand, to measure the beliefs in the importance and usefulness of a task and, on the other hand, to identify the external reasons for engaging in it (Pintrich and De Groot, 1990; Wigfield and Eccles, 2000). In our research, this perceived value focuses on the teachers' perceptions of the impact of the ICTs on the student learning and motivation (e.g., attention paid to a task and the time spent on schoolwork). This dimension includes five elements that have a very good reliability index (α=0.91).

Finally, our research takes into account a final dimension associated with the teachers' motivation for the integration of ICTs in the classrooms and self-orientation. In fact, this concept measures their dimension of demonstrating their own abilities as an objective of ICTs integration in the classroom. Moreover, this concept is generally used in contrast to task orientation, where the problem is the mastery of a task for itself rather than of its demonstration. In this sense, Nicholls (1984) and Kroll and Ford (1992) defined self-orientation as the goal of showing a strong ability to others or to oneself. Therefore, self-orientation indicates a focus on oneself in the general orientation of the activity (Whang and Hancock, 1994). In our questionnaire, this dimension is represented by three items, such as ("I use ICTs in my classroom to prove to myself that I am capable of using them in my teaching, which have a satisfactory reliability index (α=0.78).

The data used in this research was collected from teachers in the Sfax region (12 preparatory schools and 9 secondary schools). The investigated population (N=495) over 4 years from 2017 to 2020 is composed of teachers in preparatory schools (281 for students aged 13-16) and secondary schools (214 for students aged 16-20). The breakdown of teachers reflects the proportions of teachers in the sample; 61% of respondents are female teachers while their male colleagues account for only 39% of our sample. These proportions vary, however, by grade level and school year (see table 1), as women are in the majority in both grades.

Table 1: Sample composition (level of education, gender)

School	Type	2017		2018		2019		2020		Total	
		N	%	N	%	N	%	N	%	N	%
Preparatory	Women	22	4%	35	5%	42	9%	64	13%	163	33%
	Men	13	3%	21	4%	35	7%	49	10%	118	24%
	Total	35	7%	56	9%	77	16%	113	26%	281	57%
Secondary	Women	15	3%	22	4%	38	8%	62	13%	137	28%
	Men	10	2%	15	3%	20	4%	32	6%	77	16%
	Total	25	5%	37	7%	58	12%	94	18%	214	43%
Total number		60	12%	93	16%	135	28%	207	44%	495	100%

Notes: N: Number; %: Percentage.

The survey was conducted by collecting data 4 years apart. 604 teachers were asked to answer the questionnaire, the response rate was 82% and the sample was significantly representative of the population. Between 2017 and 2020, a notable evolution consists in the higher proportion of teachers trained in ICT integration in teaching while in 2017, 50% of the teachers in our sample had received training in ICT integration besides, this proportion had risen to 85% in 2020. These figures indicate that almost all the teaching staff in Sfax has now been trained in ICT integration in their teaching.

4. Data Analysis and presentation of the results

We first analyze the evolution of the teachers' feeling of competence in the technical mastery of ICTS. In a second step, we will develop the evolution of the five other dimensions of motivation, which have a pedagogical component.

4.1. Evolution of the Sense of Competence in the Technical Mastery of ICTs

Between 2017 and 2020, the sense of competence (SC) in the technical mastery of ICTs has increased. It averaged 2.50 in 2017 on a 6-step scale (1 = does not know/does not practice; 2 = novice: 3 = user; 4 = average user; 5 = good user; 6=expert). In 2020, the average was 3.91, moving away from the arithmetic mean of the scale (see Figure 1). This difference is significant at p-value < 0.01 [Tc = -

7.738]. It should be noted that at the same time, the heterogeneity among teachers in terms of their sense of competence in the technical mastery of ICTs has increased significantly. The standard deviation thus increased from 1.22 in 2017 to 1.24 in 2020. Levene's test of equality of variances indicates that this difference is non-significant at p-values = 0.464 > 5% [F(59, 206) = 0.973].

In 2017, age was a significant factor in reflecting a sense of technical competence in the technical mastery of ICTs in the classroom. A linear regression (adjusted $R^2 = 0.513$) thus indicates that the feeling of technical competence is higher among young teachers than among their older colleagues: t(493)= -22.87, p<0.000, β=-0.101. In fact, in 2017, young teachers felt that they had a higher level of technical proficiency in ICTs in the classroom. However, in 2020, age was no longer a significant factor in the sense of technical competence. In fact, older teachers had caught up with their younger colleagues in their sense of competence in the technical mastery of ICTs in the classroom. Figure 2 shows that teachers aged 36 and over have strongly developed their sense of competence in integrating ICTs into their classroom. Moreover, the greatest change can be seen in the 36-45 age group, where the average score has risen from 2.0 in 2017 to 3.88 in 2020.
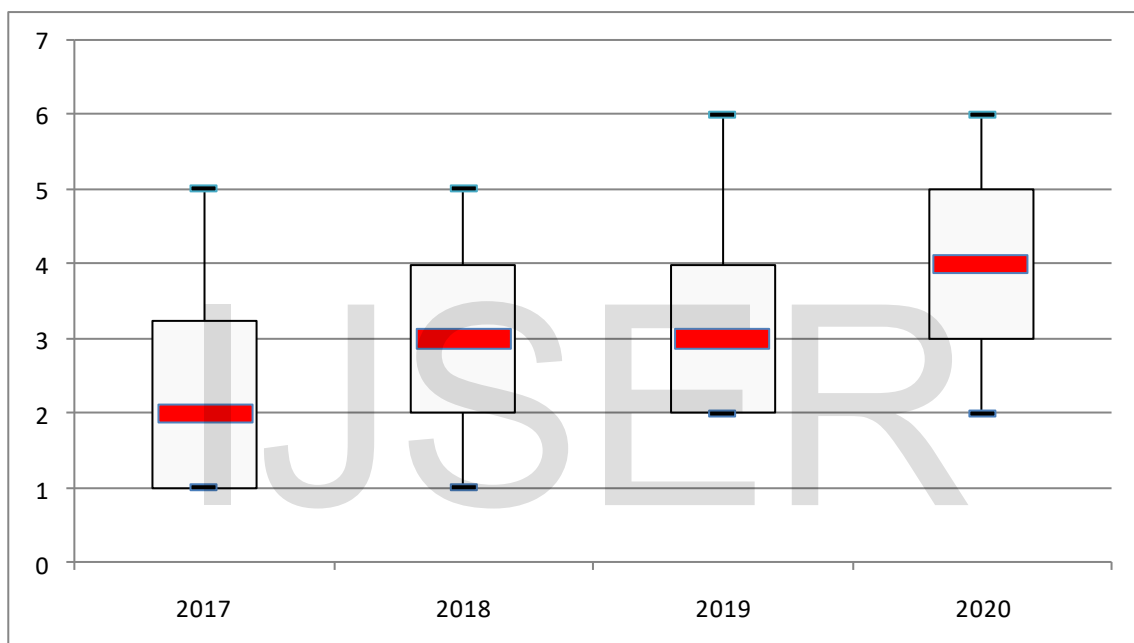

Figure 1: Mean and Dispersion of Sense of Competence in Technical Mastery of ICTs from 2017 to 2020

The level of education does not have a significant effect on the sense of competence in the technical mastery of ICTE. On the other hand, the language of instruction became significant in 2020 [F(1, 493) = 10.58, p-value=0.0012], whereas in 2017 it was not a significant factor. Language and computer science teachers (m=3.95) consider themselves more competent than their colleagues in scientific subjects (Math, Physics, Chemistry, etc.) (m=3.26) in the technical aspects associated with the use of ICTE.
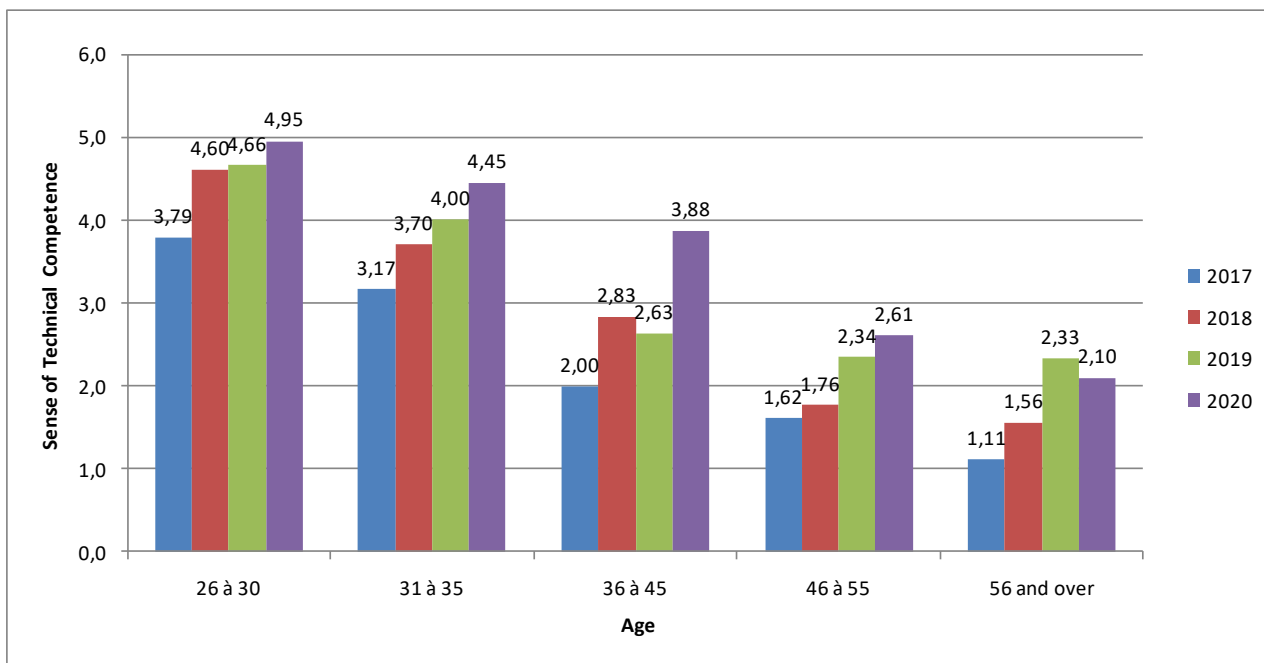
Figure 2: Sense of competency in the technical mastery of ICT skills by age group between 2017 and 2020

A difference in the feeling of competence in the technical mastery of ICTE according to the gender of the teacher was already observed in 2017 where male teachers (m=2.35) felt less competent than their female colleagues (m=2.59; tc(51)=2.008, p<0.443) but the difference is almost zero. However, while male and female teachers generally feel more competent than in 2017, in 2020 men (m=3.94) still feel more competent in the technical mastery of ICTE than their female colleagues (m=3.89; tc(155)=1.975, p-value=0.787), but these figures remained stable. Therefore, the gender gap has remained stable (see Figure 3).
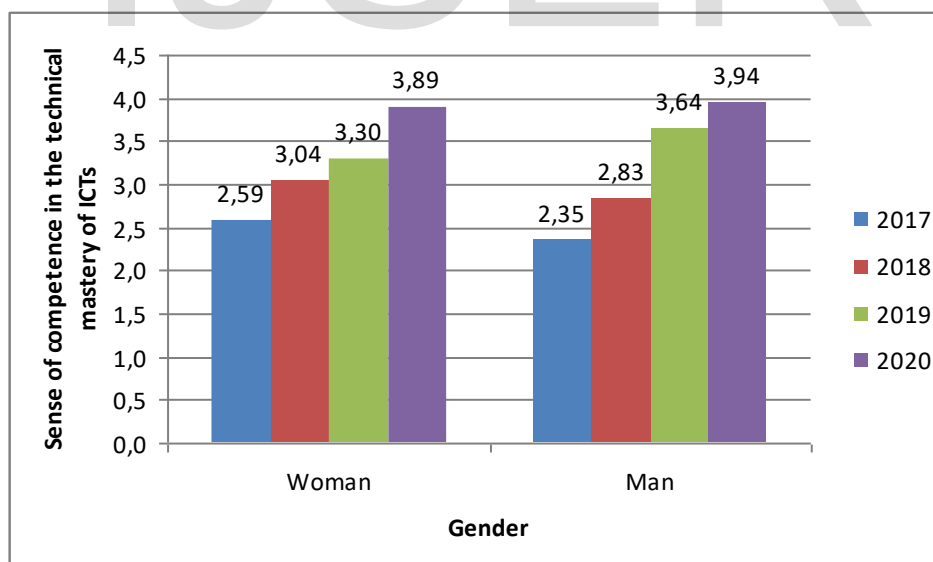

Figure 3: Sense of competence in technical mastery of ICTs skills by gender between 2017 and 2020

4.2. Pedagogical integration of ICTE: development of a sense of competence, attractiveness and self-orientation

In addition to the technical aspects associated with the mastery of ICTE, our research measures the evolution of the integration of ICTE in teaching based on the teachers' motivational attitudes towards this integration. Figure 4 and Table 2 show an increase in the teachers' sense of competence in the pedagogical assessment and integration of ICTE, as well as in the teachers' perceived attractiveness to

teaching with ICTE. The perceived value of ICTE integration has increased only slightly, while self-orientation has remained stable.

The sense of competence in assessing the pedagogical potential of the ICTs significantly increased between 2017 (m=2.3) and 2020 (m=4.3; tc(265)=1.969, p-value=0.000<0.05). A significant difference on the basis of gender appeared in 2017 (m men=3.28; m women=2.41; tc(51)=1.986, p-value=0.052<0.1). This difference between men and women tends to decrease in 2020 (m men=4.46; m women=4.12), but is still significant [tc(203)=2.113, p-value=0.036<0.05]. In 2017, there was a significant gap in the feeling of competence for the pedagogical integration of the ICTs between primary (m=2.19) and secondary levels (m=2.56; tc(490)=1.988, p-value=0.047<0.05). This gap disappeared by 2020, and primary school teachers now feel as competent as their secondary school colleagues in the pedagogical integration of the ICTs. In fact, age is not a significant factor for the feeling of competence in assessing the pedagogical potential of ICTE. On the other hand, significant differences could be observed in 2020 on the basis of subject matter: language and technology when teachers felt significantly more competent (m=4.21) than their colleagues in sciences (m=4.11; tc(490)=2.267, p-value=0.024<0.05) in assessing the pedagogical potential of ICTE.

The sense of competence for the pedagogical integration of the ICTs significantly increased between 2017 (m=2.46) and 2020 (m=4.42; tc(59)=2.0, p-value=0.063<0.1). Differences in criteria such as the teachers' gender, age or level of education also disappeared. Thus, a significant difference on the basis of gender appeared in 2017 (m men=2.26; m women=2.62; tc(55)=2.365, p-value=0.022<0.05), but this difference tended to disappear in 2020 and became non-significant. Moreover, in 2017, there was a significant difference in the feeling of competence for the pedagogical integration of ICTE between primary (m=2.12) and secondary levels (m=2.83; tc(209)=2.456, p-value=0.015<0.05) but this gap disappeared by 2020, and primary teachers felt as competent as the secondary school teachers in the pedagogical integration of ICTs.
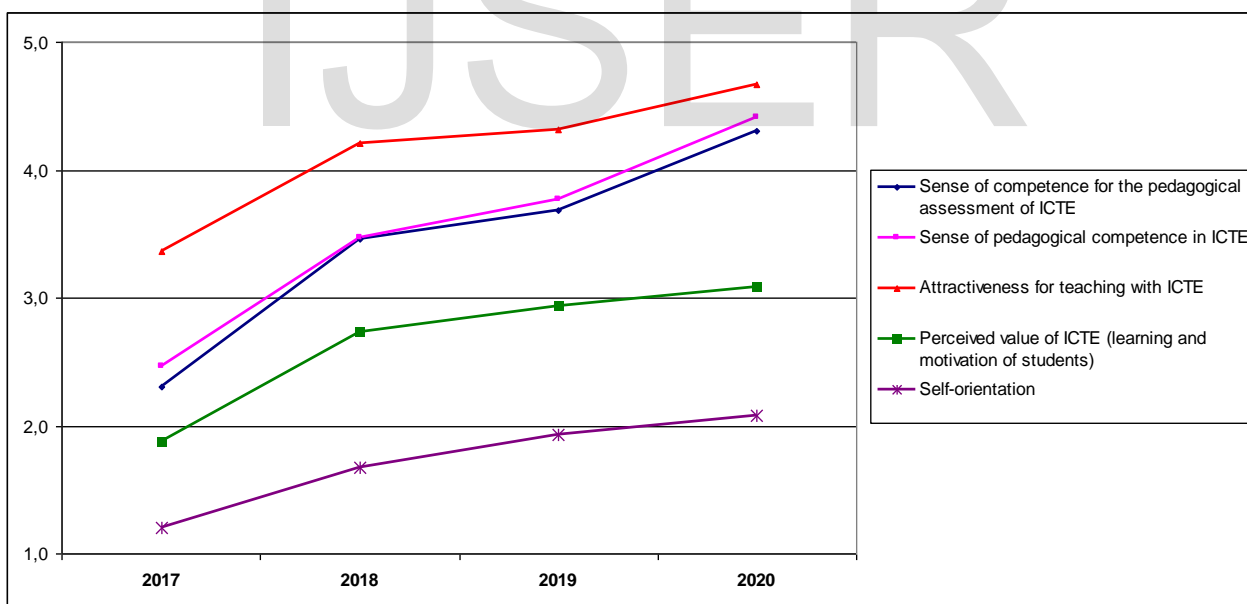

Figure 4: Changes in the teachers' motivational attitudes between 2006 and 2012
(Scale of 1=very low; 2= low; 3=medium; 4=strong to 5=very strong)

In fact, the attraction to teaching with the ICTs significantly increased between 2017 (m=3.36) and 2020 (m=4.67; tc(262)=2.198, p-value=0.029<0.05). Moreover, the differences associated with age and gender faded and became insignificant in 2020. On the other hand, we found that in 2020 there were new significant differences [tc(262)=2.009, p-value=0.046<0.05] associated with the level of education: the attractiveness of working with ICTE increased at the secondary level between 2017 and 2020 at (m2017=3.56; m2020=4.29), similarly, this attractiveness increased at the primary level at (m2017=3.42; m2020=4.78)

Table 2: Changes in the teachers' motivational attitudes between 2006 and 2012 (Scale of 1=very low; 2= low; 3=medium; 4=strong to 5=very strong)

Designation	2017	2018	2019	2020
Sense of competence for the pedagogical assessment of ICTs	2.30	3.46	3.68	4.30
Sense of pedagogical competence in ICTE	2.46	3.48	3.77	4.42
Attractiveness for teaching with ICTE	3.36	4.21	4.32	4.67
Perceived value of ICTE (learning and motivation of students)	1.88	2.74	2.93	3.08
Self-orientation	1.20	1.67	1.93	2.08

The perceived value of ICTs for education increased at a slow pace between 2017 and 2020. This difference is relatively small but rather significant (m2017=1.88; m2020=3.08; tc(262)=2.239, p-value=0.026<0.05). Therefore, gender and language have no impact on this perceived value and do not make any significant difference. On the other hand, the level of education, which also did not imply significant differences in 2017, became a significant factor in 2020 [tc(262)=2.568, p-value=0.011<0.05] whereas among the primary school teachers, it was (m2017=1.92; m2020=3.15) and among the secondary school teachers, it was (m2017=1.76; m2020=3.05).

Moreover, between 2017 and 2020, self-orientation increased but only slightly. Therefore, no factors are significant in this dimension. One small exception is that gender, which was significant in 2017, became insignificant in 2020. In fact, women seemed slightly more self-oriented (m=1.32) in the integration of the ICT than their male colleagues (m=1.01) in 2017 [tc(55)=2.008, p-value=0.049<0.05], but this difference no longer appeared in 2020.

5. Discussion and conclusion

We will now synthesize the main elements of our findings and discuss their implications, particularly with regard to future teachers' training in ICTE mainstreaming. The first observation can be made from the results is that teachers' motivational attitudes positively evolved between 2017 and 2020 in favour of the ICTE integration. More particularly, there has been a significant increase in the attractiveness of the ICTE and in the teachers' sense of competence in both the technical mastery of the ICTSE, in the evaluation of the pedagogical potential of these new tools, and in their pedagogical integration in the classroom. In our view, this development reflects a change in the stance of teachers, who increasingly see technology as a relevant resource for teaching. It shows that resistance, which is often observed when techno-pedagogical innovations are introduced (Bétrancourt, 2007) and which is due to fears linked to change and mastery of these tools, tends to diminish over time.

In our study, self-orientation remains stable. This confirms the models of motivation to which we refer since this dimension of motivation is a relatively stable trait of the person, with very little relation to context or situation (Seegers and Boekaerts, 1993). Therefore, it can be expected that it will not fluctuate much between two completions of the same questionnaire with the same population, which is confirmed in our data. The perceived value increases only slightly. The teachers' perception of the added value of the ICTE has not changed in the same way as their sense of competence or the attractiveness of integrating them. This observation reinforces the need to orient more than ever training courses on the ICTE integration towards solving concrete (organisation, differentiation, student motivation, etc.) and pedagogical problems encountered by teachers in their daily practices (Coen, 2007).

Beyond these general trends, nuances are emerging. We can thus see the beginning of a fracture at several levels. On the one hand, the heterogeneity between teachers in the technical mastery of the ICTE is increasing and it is perceived that the gaps are widening even more between the teachers who are very familiar with the technological developments and those who are struggling to master the usual ITCE tools. In our view, this gap calls into question the training institutions which - whether in initial or in-service training - should take account of the differing needs of teachers. Furthermore, it seems necessary to design a systemic dimension in the policy of integrating the ICTE by promoting the sharing of skills at schools and creating new pedagogical dynamics based in particular on collaboration. On the other hand, there is also a perceived gap in the attitudes of the teachers in upper secondary education. In fact, at the upper secondary education level, the attractiveness of working with the ICTSE decreased between 2017 and 2020. Similarly, their perceived value for student learning and motivation stagnated, in contrast to other school levels. It is therefore questionable whether these differences can be linked both to the higher age of pupils and to a certain routinization of computer use, which would lead to a loss of attractiveness among learners. In addition, the undesirable effects of technology use, such as the distractibility associated with their integration, especially for multi-functional tools, such as PDAs and tablets (Rey and Coen, 2011, 2012) - may explain the more reserved attitude of teachers towards the ICTs at the upper secondary education level. The controllability of education ICTs use decreases as one moves up the educational ladder and leads to a growing mistrust of them among teachers.

At this stage, our study enables us to assess only partially the role of the ICTE mainstreaming training courses taken by teachers in recent years therefore, further research is still needed. Indeed, societal changes (increasing importance of technologies), as well as technological innovations (tactile revolution, ergonomic progress) have certainly contributed to a more favourable attitude towards technologies among teachers. In particular, the strong improvement in the sense of competence in the technical mastery of the ICTE among teachers over 45 years of age, as well as the disappearance of age-related differences in the attractiveness of the ICTE integration are probably due to these developments. Similarly, a trend towards a decline in gender differences, which were very marked in 2017 (Schumacher and Coen, 2008), argued for a democratisation of the use of the ICTs to support student learning. In fact, teaching with technology is becoming attractive for both male and female teachers even if they feel even less competent in the technical mastery of the ICTs.

Finally, motivation always seems to be a determining factor in the integration of the ICTs. In fact, in 1989, Davis demonstrated the importance of the perceived value of the ICTs in the technology acceptance model. If time, training and technological progress seems to have affected the perception of capacity and attractiveness, the levers that act on perceived value should be considered, and the levers are still developing moderately. It is not enough to convince teachers of the advantages of "selling" technology, or to provide them with models or good practises to follow. We believe that starting from the real situation will be an interesting method. Therefore, teachers are encouraged to discuss their pedagogical practises to help them identify the source of the problems they encounter, and guide them towards tools (perhaps technical tools) that can alleviate their educational frustrations. In our opinion, encouraging people to work together (as a team) would be a good way for exploration.

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