Effectiveness of E-learning strategies in Morocco during the COVID19: Highlights from statistical association and categorical fuzzy k-modes clustering

Abdelkarim Taam[1], Amine Amar[2], Smail Kheraz[3], Abdelhak Adnane[4] and Ayoub Ait Lahcen[5]

[1] Engineering Sciences Laboratory, National School of Applied Sciences, Ibn Tofail Universty, Kenitra, Morocco
abdelkarim.taam@uit.ac.ma

[2] School of Science and Engineering, Al Akhawayn University in Ifrane, Morocco
a.amar@aui.ma

[3] Engineering Sciences Laboratory, National School of Applied Sciences, Ibn Tofail Universty, Kenitra, Morocco
smail.kheraz@uit.ac.ma

[4] Engineering Sciences Laboratory, National School of Applied Sciences, Ibn Tofail Universty, Kenitra, Morocco
adnane.abdelhak@gmail.com

[5] Engineering Sciences Laboratory, National School of Applied Sciences, Ibn Tofail Universty, Kenitra, Morocco
ayoub.aitlahcen@uit.ac.ma

Abstract. The education sector has been undergoing a general paradigm shift with the advent of technology. Thus, different teaching strategies such as, blended, flipped, hybrid or asynchronous mode were adopted through the world and especially during COVID19. In the light of this experience and because education is first an intense human interaction endeavor, different pertinent questions have arisen on the effectiveness of the online learning. In the same vein, this study was conducted in Morocco, to account for teachers experience when delivering online courses. Of the various topics addressed, particular mention was made to the use of ICT in the teaching and learning process. Performed analysis was based on an appropriate statistical methodology, namely statistical tests (Chi-squared test) and a clustering method (categorical fuzzy k-modes clustering with automated attribute-weight and cluster-weight learning). The significance of this study is twofold. First, results from the investigation would develop an understanding of teachers' engagement and main barriers when using ICT in education. Second, the results concerning the association between ICT use and different features would provide guidelines to improve the field of educational technology. Results illustrated how the teachers' experience of delivering classes involved lack of ICT infrastructure and lack of student engagement. Based on these

M. Khaldi et al. (eds.), *Proceedings of the E-Learning and Smart Engineering Systems (ELSES 2023)*, Atlantis Highlights in Social Sciences, Education and Humanities 14,
https://doi.org/10.2991/978-94-6463-360-3_37

results, implications for implementation and research were provided. The remaining parts of the study is laid out as follows: Section 1 introduces the general context of this study, section 2 incorporates review of literature, research gap and objectives. Section 3 covers research methodology, research design and data collection. Results and findings are delineated in Section 4. Section 5 concludes the paper and recommends policy implications.

Keywords: Developmental education, Digital resources, E-learning, Fuzzy clustering, Information and Communications Technology (ICT), Statistical association

1 Introduction

In early 2020, the COVID19 pandemic hit countries around the world, causing unprecedented disruptions to households, business and all vital sectors. The implementation of social distancing strategies, namely the lockdown, has led to various sudden changes at both the individual and collective levels. This situation has led to redouble efforts to identify genuine alternatives and resolution mechanisms, which show the advantages of proactive environmental management and that, mitigate the social isolation by the pandemic.

The pandemic has brought on disruptions, vulnerabilities and challenges in all facets of our lives and education is no exception. However, the pandemic formed an opportunity for schools, universities and academic institutions, to ratify and upgrade their teaching and research and thus, to implement E-learning as magic solution.

The E-learning education can be defined as the use of information and communication technologies to teach students from another location [1]. It incorporates various pedagogical methods that can possibly help students learn in such a distant environment. Taylor [2] mentioned that the distant education evolved over time in four different generations. The first was the correspondence model, the second one is the multimedia model, the tele-learning model represented the third generation and in the fourth generation, there was the flexible learning model that was based on online communication by way of the Internet. The fifth generation has already emerged, and it capitalized on the internet and the World Wide Web.

However, the distant learning and teaching setting has spawned a variety of bundles among students and teachers alike. In several educational systems, the pandemic has fostered debates regarding the limits and potential of learning platforms. Despite the outstanding efforts that teachers and professors have been making, many students may still be displeased with the new distant educational experience that they have been trying to approach. In fact, research regarding online learning and teaching shows that they are effective only if students have consistent access to the internet and thus, many of students complained about the inability to attend and connect to classes, understand the content and follow the fast course pace. In addition, many students mentioned that they have been running into several difficulties such as lack of motivation and participation, along with preconceived perceptions of online education inefficacy compared to the proximate one. Therefore, this magic solution of E-learning has a big challenge

for families who have to make the home an alternative to school. The E-learning is also a matter of whether students had the skills and abilities to use digital technology as a tool for teaching and learning and not only a tool for entertainment and pleasure.

Morocco like other countries, has taken important preventive measures to control the spread of the pandemic through banning most face-to-face activities including teaching and learning. In Morocco, it has been decided that in-person courses would be halted and replaced by distance E-learning. Thus, schools and universities used diverse platforms and policies to ensure the continuity of the teaching and learning activities such as online webinars, Massive Open Online Courses (MOOCs), recorded lectures (disseminated through TV, radio, social media and YouTube channels) and active learning (asynchronous/ synchronous). In fact, a tremendous effort was made by the ministry of education in Morocco, to provide educational institutions with computers and devices and to make internet available, in order to promote the integration of ICT in the professional practice of teachers. All these actions were taken in the context of GENIE program [3], implemented in partnership with the Moroccan-Korean Center for training in ICT and the National Center for Pedagogical Innovations and Experimentation. The pandemic has also accelerated in Morocco, the implementation of the framework law N°51.17, regulating the education system, especially article 33 and article 48 that call for the need to promote, develop and finance on line learning to support virtual classroom teaching [4]. Besides all these efforts and because education is primarily an intense effort of human interaction, various relevant questions have arisen in light of the experience of E-learning, to understand and to assess the effectiveness of the E-learning strategies in Morocco during the COVID19.

In the same vein, this study was conducted to consider the experience of teachers in delivering online courses and to investigate the perceptions and attitudes of teachers, toward their distance online learning experience amid Covid-19. This study is intended also to explore the various opportunities as well as challenges for both teachers and students. Data was collected through an online survey. Thus, 200 teachers participated in this study after the completion of a 16-week period of distance learning.

The remaining parts of the study are presented as follows: section 2 incorporates review of literature, research gap and objectives. Section 3 covers research methodology, research design and data collection. Results and findings are delineated in Section 4. Section 5 concludes the paper and recommends policy implications.

2 Related work, research gaps and objectives

Several studies were conducted in Morocco to investigate perceptions about the E-learning in Morocco during the COVID-19 pandemic. In [5], a study was conducted to investigate the limitations of e-learning platforms and how these activities are carried out in public and private moroccan universities during the containment of the coronavirus. In this study and based on quantitative and qualitative analysis, both professors and students stated that E-learning is not more interesting than regular learning. In addition, they suggest that professors should provide at least 50% of their teaching in face-to-face mode.

In the survey of 565 participants that was carried out in [6], it was discovered that the most used and preferred type of E-learning is the hybrid learning, which combines synchronous and asynchronous E-learning. In this study, 51.2% of the participants mentioned that they are not satisfied with the use of the E-learning.

According to [7], many obstacles arise when assessing the effectiveness of the E-learning. The authors mentioned the psychological impact, access to Internet, use of digital tools, skills and engagement of learners to use ICT.

In a study of 741 participants cited in [8] and that was carried by ENSAM-Casablanca, it was discovered that 8 out of 10 students are not pleased with an ill prepared for online education.

The statistical analysis conducted in [9] showed a significant correlation between subjects taught and distance learning and a weak correlation between follow-up training and distance learning during the lockdown period.

In [10], it has been mentioned that the e-learning system is determined by both the system usage and the learner satisfaction. In this system, the quality of the approach and the content delivered the instructor has direct and significant influence.

Hanteem, A and his team performed a qualitative study [11] that targeted university students from faculties and higher institutes. Obtained results showed that 83% of the respondents failed to concentrate on their studies and where apprehensive about their exams, while 17% were not influenced by the lockdown situation. The results also revealed that 78% of the participants conveyed satisfaction with their teachers' involvement and commitment to meet the objectives of distant learning.

3 Materials and methods

3.1 Research methodology

This study explores the teachers' experiences in online teaching and E-learning. The aim is to analyze teachers' engagement and main barriers when using ICT in education, in order to provide guidelines to improve the field of educational technology. In this context, our analysis is based first on the identification of the association between ICT use and age, teachers' experience, cycles and others pertinent features. The idea is to know whether the use of ICT is different when exposed and unexposed subjects; teachers; are contrasted in our observational study.

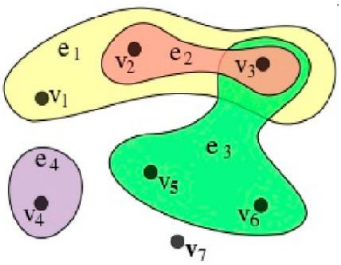
In statistics, two variables are associated if information about the value of one variable provides information about the value of the other variable. Chi-squared test [12] is used to identify statistical associations and results are considered significant if corresponding p-value is less than 0.05. It is worth to note that the Chi-squared is selected based on outputs from the exploratory data analysis. In fact, to achieve the comparison between selected groups of teachers, according to their ages, cycles or other characteristics, different alternatives can be considered. However, some assumptions and specifications are required to ascertain the validity of the statistical results.

Table 1. Statistical approaches for comparison

Purpose	Characteristics of outcome variables		
	Quantitative Normal distributions	**Quantitative Asymmetric distribution**	**Qualitative**
Describe	Mean & Variance	Quartiles	Frequency
Compare two independent groups	t-test for independent groups	Mann-Witney test	Ch-Squared test or Exact Fisher test
Compare two matched groups	t-test for matched groups	Wilcoxon test	Mc Nemar test
Compare more than two independent groups	ANOVA	Kruskall-Wallis	Chi-Squared test
Compare more than two matched groups	Repeated measures ANOVA	Friedman test	Q-Cochran test

The second step of our methodology is to perform clustering process with the idea to classify similar teachers regarding their engagement and use of ICT, by using an unsupervised learning algorithm according to their similarity. In fact, the clustering process is the most effective unsupervised classification to summarize complex external information and in addition, data clustering with categorical attributes has been widely used in many real world applications. However, there are still challenges for the clustering algorithm regarding how to eventually realize cognition, learning and classification under unsupervised conditions by extracting data features.

Most of the existing clustering algorithms proposed for the categorical data face two major drawback of termination at a local optimal solution and considering all attributes equally. However, many recent developments exist, such as the fuzzy k-modes algorithm, which generates a fuzzy partition matrix for the categorical data, and gives confidence to objects in different clusters [13]. In his fuzzy k-modes algorithm, Huang [14] introduced the fuzzy component in clustering categorical data, to overcome drawbacks of crisp clustering that did not take into account uncertainty. The intuitionistic fuzzy set (IFS), introduced by Atanassov [15] based on the concept of fuzzy set theory, has been used by Huang to enhance the clustering performance (for more details, see [16]). The figure below summarizes the main steps of intuitionistic fuzzy k-modes algorithm:



Step 1. Assign initial cluster centers or modes for c clusters.
Step 2. Between data objects X_i and centroids Z_l the distance d is calculated.
Step 3. The fuzzy partition matrix or membership matrix U is generated
Step 4. Compute the hesitation matrix π using

$$\pi_{li} = 1 - \mu_{li} - \frac{1-\mu_{li}}{1+\lambda\mu_{li}}.$$

Step 5. Compute the modified membership matrix U' using

$$\mu'_{li} = \mu_{li} + \pi_{li}.$$

Step 6. The X_i with higher relative frequency of categorical attributes is chosen to be the new representative, i.e., center or mode.
Step 7. By using Steps 2-5 the new partition matrix is calculated.
Step 8. If $\|U'^{(r)} - U'^{(r+1)}\| < \varepsilon$ then stop. Else repeat from Step 4.

Fig. 1. Intuitionistic fuzzy k-modes algorithm.

We can mention also the genetic intuitionistic weighted fuzzy k-modes (GIWFKM) algorithm which performs the unsupervised feature selection based on the correlation coefficient, to remove some redundant features and thus, to improve the clustering performance and to reduce the computational time [17].

In our study, we used the categorical fuzzy k-modes clustering with automated attribute-weight and cluster-weight learning [18]. In this proposed clustering process, a new distance function is proposed and a local attribute weighting mechanism is used to weight the attributes of each cluster properly. Attribute weight and cluster weight are learned simultaneously and automatically during the clustering process. The figure below summarizes main steps to implement the FKMAWCW algorithm:

Algorithm 1. FKMAWCW clustering algorithm.

Input: Dataset $\chi = \{x_n\}_{n=1}^{N}$, Initial centers $C^{(0)}$, Number of clusters K, Number of attributes M, Secondary parameters t_{max}, p_{max}, p_{init}, p_{step}, ε, Exponent of attribute weight q, Fuzzy degree α, and distance function coefficient β.
Output: Membership matrix **U**, Cluster centers matrix **C**;

set $t = 0$
set $p_{init} = 0$
set $z_k^{(0)} = \frac{1}{K}$, $\forall k = 1 \dots K$
set $w_{km}^{(0)} = \frac{1}{M}$, $\forall k = 1 \dots K$, $\forall m = 1 \dots M$
set empty= **FALSE** //No empty or singleton clusters yet detected
$p = p_{init}$
repeat
$t = t + 1$
Update the cluster assignments matrix **U** by Eq. (3)
If empty or singleton clusters have occurred at time t **then** //reduce p.
    empty=**TRUE**
    $p = p - p_{step}$
    if $p < p_{init}$ **then**
        return NULL
    end if
    //Revert to the assignments and weights corresponding to the reduce p.
    $u_{nk}^{(t)} = [\mathbf{U\_history}^{(p)}]_{nk}$, $\forall k = 1 \dots K$, $\forall n = 1 \dots N$
    $z_k^{(t-1)} = [\mathbf{Z\_history}^{(p)}]_{k}$, $\forall k = 1 \dots K$
    $w_{km}^{(t-1)} = [\mathbf{w\_history}^{(p)}]_{km}$, $\forall m = 1 \dots M$, $\forall k = 1 \dots K$
end if
Update the cluster center matrix **C** by Eq. (4)
if $p < p_{max}$ **and** empty=**FALSE** then //increase p.
    $\mathbf{U\_history}^{(p)} = [u_{nk}^{(t)}]$ //store the current assignment in matrix $\mathbf{U\_history}^{(p)}$.
    $\mathbf{W\_history}^{(p)} = [w_{km}^{(t-1)}]$ //store the previous attribute weights in matrix $\mathbf{W\_history}^{(p)}$.
    $\mathbf{Z\_history}^{(p)} = [z_k^{(t-1)}]$ //store the previous cluster weights in matrix $\mathbf{Z\_history}^{(p)}$.
    $p = p + p_{step}$
end if
Update the attribute weight matrix **W** by Eq. (7)
Update the cluster weight matrix **Z** by Eq. (8)
until $|F^{(t)} - F^{(t-1)}| < \varepsilon$ ***or*** $t \geq t_{max}$
return U, C

Fig. 2. Categorical fuzzy k-modes clustering with automated attribute-weight and cluster-weight learning (FKMAWCW).

All statistical computing and graphics were carried out with Matlab and R programming language. Our methodology is summarized below, where the figure 3 provides an overview of the implemented steps.

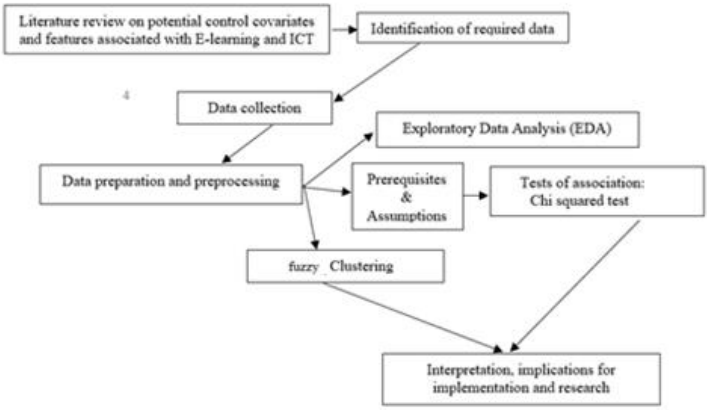


Fig. 3. Overview of used research methodology.

3.2 Research design and data collection

Data is collected through an online questionnaire, to gain time and to ensure responsiveness. Of the various themes addressed, a particular mention was made to the use of ICT in the teaching and learning process, modes of learning and disparities between students in terms of technology use and cognitive abilities. 200 teachers are selected according to their age groups, gender, expertize area, experiences and sectors to cover various segments and opinion. Feedbacks were received and answers were first analyzed by reviewing individual responses, to assess the quality of the answers. Additional interviews were organized with some teachers when the need arises. Answers are coded numerically and analyzed with appropriate quantitative methods.

Table 2. Summary descriptive statistics

Age	**%**	**Gender**	**%**
[20-30 yrs [	34.0	Male	62.5
[30-40 yrs [	31.5		
[40-50 yrs [	24.0	Female	37.5
[50-60 yrs [	10.5		
Area of expertise	**%**	**Experience**	**%**
Sciences	31.5	[1-5 yrs]	37.5
Humanities	51.5	[6-10 yrs]	16.0
		[11-15 yrs]	13.5
Languages	17.0	[16-20 yrs]	13.5

		More than 20 years	19.5
Degree	**%**	**Cycle**	**%**
Bac	11.0	Primary school	33.0
Bachelor	59.0	High school and college	30.5
Master	21.0		
PhD	9.0	Vocational secondary level	36.5
Sector	**%**	**Area**	**%**
Public	92.0	Rural	33.0
Private	8.0	Urban	67.0

4 Results and findings

Teachers' attitudes towards distant learning differ from a teacher to another depending on several social, geographical and technical factors, but it has been discovered that in overall, 46.5% did not use ICT and 86% devote less than or 50% of their time to the use of ICT in the teaching. Even if for those how use the ICT, a variety of issues arisen, such as poor network connectivity (81.5%), lack of computers (96%) or the fact that students are insufficiently prepared and experienced (51%). A mitigated result appears when talking about the use of ICT applications for teaching. In fact, 53.5% of professors confirm the use and 46.5% didn't confirm. Text processing presentations and e-mail are still the main used applications. When discussing the time devoted to the use of ICT in teaching, only 13.5% have confirmed using ICT during more than 50% of their time.

Besides logistical imperfections and social disadvantages, the teachers give informal perception such as the belief that traditional education is irreplaceable. Teachers mentioned that they are not sure if students understand their learning content or not and therefore, the perception of whether online learning is beneficial to students are not unanimously constructive.

Table 3. Use of ICT in the learning process

Poor network connectivity	**%**	**Technological devices**	**%**
No	18.5	Smartphone	88.5
		Laptop computer	31.0
		Personal computer	62.5
Yes	81.5	Tablet	11.5
		Smart TV	16.0
		No equipment	0

Main barriers that prevent ICT in teaching and learning	%	Use of ICT applications for teaching	%
Lack of computers	96.0		
Lack of pedagogic textbook	41.5		
Insufficient number of computers	42.5		
Inexperienced students	51.0		
Lack of knowledge of educational web-sites	18.5	Yes	53.5
Poor or inadequate training	46.5		
Lack of time	47.5		
Overcrowded classrooms	57.5		
Prejudices. beliefs and customs	15.0	No	46.5
Scarcity of educational websites	23.0		
Resistance to change	19.0		
Lack of conviction	17.0		
Educational process or human character	14.0		
Weak desire to use ICT	16.5		

Use of technological devices in learning process	%	General use of technological devices	%
No	33.5	No	46.5
Yes	66.5	Yes	53.5

Use of specific applications	%	Time devoted to use of ICT in teaching	%
Text processing	86.0	0%	6.5
Presentations (PPT)	73.0	10%	42.5
E-mails	60.0	20%	14.5
virtual classrooms	31.0	30%	8.0
Videos processing	41.0	40%	7.0
images processing	0.0	50%	8.0
Sound processing	23.0	60%	3.5
Excel spreadsheet applications	52.5	70%	3.0
multimedia software	28.5	80%	3.5
Access database	12.5	90%	2.0
		100%	1.5

The analysis, based on Chi-squared test, confirms that the use of ICT in the teaching process is more associated with the expertise area. In addition, there is a statistical difference in terms of gender and rural and urban area, when it comes to take advantages from virtual classrooms. We can also mention the statistical difference in term of time devoted to use of ICT in teaching, according to the area of expertise and geographical factor (rural/urban area).

Table 4. Chi-squared association test (p-value and signification) between the use of ICT in the learning process and different features

	Age	Gender	Educa-tion level	Cycle	Expertise Area	Experience	Sector	Area (Urban/ rural)
Teaching	3.841 Sig: 0.279	0.387 Sig:0.534	8.223 Sig:0.042	5.738 Sig:0.057	11.385 **Sig:0.003**	5.210 Sig:0.266	1.626 Sig:0.202	1.689 Sig:0 .194
Text processing	0.719 Sig: 0.869	1.107 Sig:0.293	5.972 Sig:0.113	4.063 Sig:0.131	0.930 Sig:0.628	1.765 Sig:0.779	0.868 Sig:0.352	4.256 **Sig:0.039**
Presentations PPT	4.212 Sig: 0.239	1.522 Sig:0.217	19.992 **Sig:0.000**	11.361 **Sig:0.003**	14.814 **Sig:0.001**	7.143 Sig:0.129	0.601 Sig:0.438	4.382 **Sig:0.036**
Emails	2.275 Sig: 0.517	0.089 Sig:0.766	10.974 **Sig:0.012**	3.858 Sig:0.145	7.188 **Sig:0.027**	2.868 Sig:0.580	0.555 Sig:0.456	6.969 **Sig:0.008**
Virtual classrooms	3.646 Sig: 0.302	8.534 Sig:**0.003**	6.140 Sig:0.105	4.809 Sig:0.090	2.529 Sig:0.282	1.980 Sig:0.739	0.344 Sig:0.558	4.412 **Sig:0.036**
Access database	4.176 Sig: 0.243	3.733 Sig:0.053	9.039 **Sig:0.029**	0.756 Sig:0.685	5.908 Sig:0.052	5.516 Sig:0.238	2.484 Sig:0.115	2.184 Sig:0.139
Videos processing	6.315 Sig: 0.097	0.138 Sig: 0.710	3.247 Sig:0.355	0.872 Sig:0.647	5.005 Sig:0.082	3.139 Sig:0.535	0.088 Sig:0.767	1.541 Sig:0.214
Sound processing	2.191 Sig: 0.534	0.188 Sig: 0.664	1.172 Sig:0.760	2.660 Sig:0.264	3.422 Sig:0.181	4.048 Sig:0.400	0.668 Sig:0.414	0.607 Sig:0.436
Excel applications	5.078 Sig: 0.166	1.637 Sig:0.201	7.622 Sig:0.055	3.851 Sig:0.146	17.951 **Sig:0.000**	8.716 Sig:0.069	0.044 Sig:0.835	4.010 **Sig:0.045**
Multimedia	0.387 Sig: 0.943	3.025 Sig:0.082	2.576 Sig:0.462	2.646 Sig:0.266	14.833 **Sig:0.001**	1.511 Sig:0.825	1.985 Sig:0.159	0.364 Sig:0.547
Time devoted to use of ICT in teaching	42.008 Sig: 0.071	11.706 Sig:0.305	35.298 Sig:0.232	25.479 Sig:0.184	31.723 **Sig:0.046**	40.305 Sig:0.457	17.666 Sig:0.061	19.541 **Sig:0.034**

Because there are different perceptions regarding the use of ICT and the effectiveness of e-learning strategies, the following features were used to identify clusters of teachers, regarding their perceptions:

Table 4. Features used to implement the categorical fuzzy k-modes clustering with automated attribute-weight and cluster-weight learning

Age	Gender	Use of ICT tools in education
[20-30 yrs [	Male	Yes
[30-40 yrs [		
[40-50 yrs [	Female	No

[50-60 yrs [

Area of expertise	Experience	Use of ICT apps in education
Sciences	[1-5 yrs]	Yes
Humanities	[6-10 yrs]	
	[11-15 yrs]	
Languages	[16-20 yrs]	No
	More than 20 years	
Degree	**Cycle**	**Do you think that digital education solve students cognitive issues**
Bac	Primary school	Yes
Bachelor	High school and college	
Master		
PhD	Vocational secondary level	No
Sector	**Area**	**Do you think that digital education can improve students education level**
Public	Rural	92.0
Private	Urban	8.0

The FKMAWCW algorithm splits the population of the teachers into 3 clusters, according the aforementioned features.

Cluster1 mainly comprises teachers from public sector and languages and humanities area. For this cluster, the majority of teachers did not use ICT tools and apps in education and they have a mitigate answers in relation with impact of digital education on student education level and cognitive issues.

Cluster 2 mainly comprises male. Teachers from this cluster comes from urban public sector and use ICT tools and apps in education. Science is the area of expertise that characterize this cluster. Teachers believes that digital education has a positive impact on students' education level and cognitive issues.

Cluster 3 mainly comprises female. Teachers from this cluster have a mitigate perception in terms of the use of ICT apps and the impact of digital education. However, the majority of teachers from this cluster use ICT tools.

Table 4. Identifications of clusters memberships

Clusters	Frequency	Members of the cluster (teachers)
Cluster1	69	2; 6; 10; 28; 32; 34; 35; 36; 37; 38; 39; 40; 42; 50; 52; 55; 59; 65; 66; 67; 70; 75; 76; 79; 81; 89; 91; 93; 94; 96; 97; 98; 99; 104; 105; 107; 108; 109; 110; 112; 114; 115; 116; 120; 121; 123; 134; 136; 140; 147; 159; 160; 163; 165; 169; 170; 171; 174; 175; 176; 178; 179; 181; 185; 186; 188; 191; 193; 195
Cluster2	62	1;4;9;12;13;14;16;22;26;27;29;31;33;43;45;46;48;51;53;54;56;57;58;61;62;63;64;71;72;73;74;77;82;83;85;86;87;88;90;100;101;103;119;122;125;126;128;135;137;138;141;144;152;162;164;168; 183;187;189;192;197;198
Cluster 3	69	3;5;7;8;11;15;17;18;19;20;21;23;24;25;30;41;44;47;49;60;68;69;78;80;84;92;95;102;106;111;113;117;118;124;127;129;130;131;132;133;139;142;143;145;146;148;149;150;151;153;154;155;156;157;158;161;166;167;172;173;177;180;182;184;190;194;196;199; 200

5 Conclusion

The COVID19 has brought social and structural issues and had a severe impact on education as universities and schools closed their premises. Although education institutions were quick to replace face to face lectures with online learning that is becoming now the new standard in education. However, this magic solution, obliged practitioners, teachers and students to readapt to a new situation and to work hard to find appropriate conditions to make this new endeavor a timely success.

In practical terms, more efforts are required to improve to quality and the efficiency of the learning and the teaching process, by using ICT in order to guarantee a good integration and to ensure a transition towards a modernized education system. However, students who have the suitable technology and the appropriate mind-set are likely to have an effective online learning experience, but those who are not lucky to have access to good technology infrastructure or do not have required skills face significant challenges.

In the moroccan context and based on this study, the perception about the online learning and the use of ICT are still mitigated. Collected answers bring to mind different barriers that make the situation complicated. We can mention in particular the availability of suitable infrastructures, especially those related to support professional development, the global strategy for the implementation of ICT and the general characteristics of the moroccan education system.

Consequently, to remain relevant, schools need reforms and extensive innovative changes in logistics and attitudes. This can only happen, if there is a more technical preparedness with the necessary online educational resources and training programs for both teachers and students. In this context, schools need to reinvent their learning environments so that digitalization expands and complements student teacher and other

relationships. In this context, it would be necessary to think about a global support and monitoring policy and involvement of social stakeholders in the promotion of successful initiatives.

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