Understanding the role of modern technologies in education: A scoping review protocol

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Our scoping review of the literature explores data related to the influences of modern technologies in education between 1998 and 2018. This comprehensive search method was made using ProQuest, Springer Link and Science Direct Journal databases. The search strategy led to the review of 264 studies, of which 33 were identified as relevant to this research. The methodology used is the scoping review, and it is developing a background to investigate both positive and negative impacts of predictors' variables related to the use of modern educational technology in education. We point out four distinct digital technologies with which educational strategies can be improved: laptop, software, internet and social network. We aim to identify the strengths, weaknesses, opportunities and threats related to the modern technologies used in education. This paper contributes to deeply understanding the evolution during the past 20 years of the main digital educational tools. This study has an innovative feature because it extracts the frequency of strengths, opportunities, weaknesses and threats highlighted by the use of modern technologies in education. A brief history of the development of new digital tools, a comparative analysis of them and a few recommendations for future research directions was provided.

Keywords: databases, education, modern technology, protocol, scoping review

Usually, the quality of the educational activities is imposed by legislation and estimated through the academic performances of students. But there are some other factors that can be analysed to complete the picture of the efficiency of the educational process, such as investigating the perception of modern technologies used in education that is changing the way students and teachers learn.

Moreover, there are many applications of technologies in education that are varying the method we study, creating a more accessible environment for students involve PCs or smart devices. Thus, current educational strategies accentuate that digital tools contribute to students knows, as well as offer more details about different subjects usually difficult to understand.

New information technologies (IT) represent all the instruments with which different data is centralised, stored and disseminated automatically in a time shorter than for other media. Nowadays, with the help of IT tools, most of the existing processes can be automated. Moreover, as Xiong and Lim point out, 'effective training with ICT has to focus on the exchanges between technology, pedagogy, and subject content' (Xiong & Lim, 2015). Also, many different classifications of information and communication technologies (ICT) -based learning technologies were proposed (Marion, 2017).

However, after studying specialised literature and the theoretical framework we observed the lack of highlighting the positive and negative aspects of the new digital tools use in education. So, the purpose of this scoping review is: (1) to extensively research the literature relating the modern technologies used in education; (2) to summarise detailed features of these tools and their descriptions by users' Perceptions; and, (3) to map the use of new digital tools according to each category variable proposed to be investigated (e.g., authors' country, teaching objectives and SWOT perceptions).

The outcomes will be provided by a scoping review procedure. Thus, this research aim not only to characterise the modern technologies used in education but also to explore the strengths and weaknesses of them. The results will allow educational organisations to deliberate the quality of teaching performance in order to improve the digital facilities that reveal what students need.

LITERATURE REVIEW

To understand the impact of technology used, especially in the educational process, we must take into account the historical evolution and their dynamics regarding ICTs use in education. Consequently, the main ICT tools will be presented in chronological order.

First computer

The first computer was a device think of and designed by Charles Babbage who work on the analytical engine which was to be a truly general-purpose digital computer between 1833 and 1871 (Wilkes, 1977). Later, in 1943, after John Mauchly and Proper Eckert developed numerical methods, they built the first electronic computer called ENIAC (Grier, 2001; Iancu, 2012).

Portable computers

Sustained research in the field has led to the miniaturisation of electronic components (Iancu, 2012). Modern computers deliver users' tools, data storing and social opportunities that can be used for educational purposes (Bando, Gallego, Gertler, & Fonseca, 2017).

Fixed and mobile memory

Efficient use of physical resources which includes memory device had a major influence on its effectiveness and performance. For these reasons, it has invested gradually in the digital services in terms of their storage capacity and data processing (Mishra & Kulkarni, 2018).

Computer peripherals

A definition of computer peripherals is given by Sinclair (Sinclair, 2011): 'the computer peripheral is a device that is connected to a computer to perform such actions as display, printing, selection of operations, communication, etc.' These peripheral devices (computer monitor, keyboard, modem, etc.) facilitates connection and data visualisation on the internet. Obviously, their continuous improvement leads to an improvement in the functioning of the Internet.

Computer peripherals

Educational software is used in various domains (e.g., engineering, medicine, agriculture, natural sciences, etc.) to facilitate teaching and learning using a modern curriculum. Modern educational strategies can include the use of any software educational involving students' knowledge quickly and efficiently and acquisition of their practical skills. Also, the ability to apply students' knowledge in practical cases was stimulated. In conclusion, educational software contributes to a motivating integrated learning initiative, autonomy and creativity (Salas-Morera, Arauzo-Azofra, Garcia-Hernandez, Palomo-Romero, & Hervas-Martinez, 2013).

The internet of things

Internet development had an impressive trajectory in recent years. The first communication tools were developed thanks to the Web 1.0 and consisted in providing basics and presently used widely, such as email and chat rooms (Namisiko, Mindila, Chepkoech, & Nyeris, 2014). The World Wide Web (Web) has grown continuously due to the growing number of users browsing the web, taking Web 2.0 form and then Web 3.0 (Garcia-Alvarez, Novo-Corti, & Varela-Candamio, 2018). Currently, the internet significantly guides the perception of the events that happen around us, and how we make decisions for us or those close to us, including the field of education. Essentially, the Internet considerably influences our lives every day because of multiple applications at communication, health, smart cities, climate and weather and preference for professional development (Kouicem, Bouabdallah, & Lakhlef, 2018).

Social networks

New educational technologies are available, being in a continuous improvement and adaptation to new changes in the communication between users. Studies have led to the miniaturisation of digital components and greater independence to a permanent power source. In addition to continued improvement of data storage devices, the big data platforms and big data analytics software were performed. Note that transmission and processing digital plays an important role in the educational process, both in terms of students and teachers.

Different types and uses of social networks, as presented by Al-Aufi and Fulton (2014) and other researchers (Gayathri, Thomas, & Jayasudha, 2012) are the following: (1) social networks (e.g., Facebook, Twitter, Google+, LinkedIn, etc.); (2) integrated multimedia solution (e.g., YouTube, iTunes, Craigslist, Technorati, Flickr, TED talks, Picasa, Instagram, etc.); (3) specialised software (e.g., GPari, Jacal, LinkedIn, Mathematica, Classroom 2.0, etc.); (4) academic software (e.g., Maple for Home Use,

Academia.edu, Minitab for Students, Microsoft Office and Windows for Home Use, Qualtrics Survey Software, etc.); (5) blogging (e.g., Tumblr, Blogspot, WordPress, etc.); (6) Social Bookmarking websites (e.g., Pinterest, StumbleUpon, Digg, Reddit, etc.); and, (6) messaging apps (e.g., WhatsApp, Viber, Skype, etc.).

In recent years, there have been major changes in social networking architectures. Permanent updating of modern telecommunications technologies and ways of online communication had a significant impact on the development of social networks (Babutsidze, 2018). Moreover, changing vision users on ways of interaction and networking in the virtual environment, with visible positive results relative to its efficiency and utility, made it possible to increase the users' confidence and also to increase the number of who access social networks (Amato et al., 2018; Yu & Li, 2018).

Inclusive learning implies the harmonisation between the teaching strategies and the students' attitude towards learning (Panisoara, Duta, & Panisoara, 2015). Therefore it is mandatory to configure a suitable learning environment including specific needs of each student (Spratt & Florian, 2015). This approach involves promoting teaching strategies (Duta, Panisoara, & Panisoara, 2015) that meet individual learning styles, which is perfectly feasible if strategies containing the use of modern educational tools. In this context, teachings objectives are closely correlated with the use of digital tools (Fong et al., 2014).

Summary, for students the role of modern technologies used in education means: (1) interactive instruction (Caballero et al., 2014; Fiorentino, Uva, Gattullo, Debernardis, & Monno, 2014; Turel & Demirli, 2010); (2) better understanding of data that can be visualised (Hoelscher & Mortimer, 2018); (3) reducing barriers between students caused by space and time (Pacheco, Lips, & Yoong, 2018; Rathore et al., 2018); (4) personalised learning, according to the students' needs (Garrido, Morales, & Serina,2016); (5) support students with disabilities (Pacheco et al., 2018); and, (6) facilitates sustainability behaviours of students (Ali, Murphy, & Nadkarni, 2014; Fumiyo, 2007);

Additionally, summary, for instructors the role of modern technologies used in education means: (1) sources of free access to data (Rossetto et al., 2018; Shahrivar, Elahi, Hassanzadeh, & Montazer, 2018); (2) real-time processing data that facilitate which facilitates the understanding of the topics addressed (Esch et al., 2018; Ward et al., 2018); (3) increase understanding of task demands (Licorish & MacDonnell, 2018; Smith et al., 2018); (4) support for collaboration (Relojo & Pilao, 2016) and perform collaborative analyses in real-time (Bianchi, Casnici, & Squazzoni, 2018; Caglayan & Bener, 2016; Magdaleno, de Oliveira Barros, Werner, de Araujo, & Batista, 2015; Raibulet & Fontana, 2018; Zec & Matthes, 2018); (5) use of unconventional instruction resources to solve different difficulties in the educational process (Horejsi, 2015; Portegies Zwart et al., 2009); (6) learn new skills by self-training (Gravill & Compeau, 2008); and, (7) professional development for improving their ICT skills (Alt, 2018).

METHODS

Protocol design

The key selection condition was to survey all studies which contain the following aspects: (1) studies contain the selected independent variables (e.g., laptop use, software use, internet usage and social network use); (2) the studies present qualitative, quantitative or mixed research related to the impact of the selected variables on the educational process; and, (3) the results of the studies considered as positive, opportunities, weaknesses and threats for education (Castellacci & Tveito, 2018). According to this context, we well-defined three main phases to explore these studies namely, research design, research experiment, and results description (Ahmad, Dennehy, Conboy, & Oivo, 2018).

Thus, each step contains different issues well-matched with the proposed aims: (1) finding the research question namely: what is known about the impact of each modern technology use on students learning behaviours; (2) identify significant studies; (3) recording the data; (4) ordering the collecting qualitative data, (5) brief the outcomes; (6) Strengths, Weaknesses Opportunities, Threats (SWOT) analyse results; and, (7) discussing the results.

Identification of selected studies

The process of identification of studies to be analysed and mapped is necessary to the success of this study (Ahmad et al., 2018). Search engines have relied on a combination of key terms, namely: the use of each instrument and education. Selected studies which contains search terms as: laptop use, software use, internet use, social network use and education tools will specify: authors, year of publication, country to which authors are affiliated, types of modern technology, participants, methodology used and associated psychometric indicators, a brief presentation of the results, teaching objective and appreciation of the issues highlighted as: strong aspects (S), opportunities (O), week aspects (W) or threats (T).

Data analysis

In order to limit the errors that may occur due to the degree of subjectivity of the selection for the final analysis were retained only those works that fulfilled several predefined quality conditions such examples, the papers were published in prestigious peer-reviewed journals. In addition, each research was fully and twice investigated separately by the authors to ensure the validity of the final results.

RESULTS

In this section, we synthesised and interpreted the results of the investigation of the 33 selected articles (some of them contain references of two digital tools). The results are the consequence of research questions and include: summary of outputs, teaching objective and SWOT analysis. The distribution of selected tools per articles was reproduced in Table 1.

Table 1
Selected Tools and Article Count

Tools used	Article count
Educational software	16
Internet	6
Laptop	11
Social network	8
Total	41

Qualitative results

One of the aims of this work is to summarise tools individually. Table 1 shows the outcomes in the case of each predictor's variables investigated.

Although laptops bring benefits to users especially when learning theoretical knowledge, they are not used in class by students only for homework assignments. However, it has been found that pupils are more active in social networks if they have their own laptops, but it is necessary to train them ethically

and to monitor their activity taking into account multitasking behaviour. In some universities, there are few references to the widespread use of the software specialised education. For these reasons, the educational research needed to understand the users' opinions about the role of computer applications in education suffers. Another problem is the lack of quality indicators for software, in terms of technological, cultural, behavioural and social. Including content, evaluation is required for each application that is accessible from any device with a browser and has provided different levels of difficulty. The results of software applications can be subsequently validated by simulation. Creating special educational resources is also particularly useful for teachers, especially for students with learning difficulties.

Another important direction in educational research is to monitor the use of the internet in terms of educational performance, but also to investigate the conditions under which internet use can reduce or enhance existing educational inequalities. The efficiency of the internet depends on the type of users, by the subjects they are looking for, of online users and whether they want to improve their knowledge of internet browsing. Thus, we can say that internet use has strong positive effects but differentiated by a social group of users. In the case of the internet, students' perceptions are positive about their usefulness in education, but blogs (Relojo, 2017), wiki portals and e-learning are not specifically endorsed by users. It is, therefore, necessary to adjust virtual learning environments to students' preferences and needs. The use of social networks has a positive influence on the accumulation of new students' knowledge. These facilitate the production of new special educational resources for school teachers, including the development of an informal curriculum.

Associations with teaching objective

Another aim of this research question is to map the new digital tools use according to each category variable proposed to be investigated (e.g., teaching objectives and SWOT perceptions).

From Table 2 we can see that most teaching objective can be achieved by using a laptop. An educational software can be used to realise mainly training, simulation, investigation, exercise and evaluation. The fewer teaching objectives can be achieved only using Internet resources unconnected to other tools.

Table 2
Selected Teaching Objective and Modern Technologies

Teaching objective	Modern technology			
	Laptop	Software	Internet	Social network
Training	x	x		
Simulation		x		
Investigation	x	x		x
Exercise	x	x		
Team	x			
Classroom observation	x			
Assessment	x	x	x	x
Adapt teaching strategies			x	x

Educational software is most commonly used to adapt teaching strategies, simulation and training, and less for classroom observations. Laptops are regularly used for investigation and evaluation. Internet network, as well as social networks, are used most frequently to adapt teaching strategies as can be seen in Figure 1.

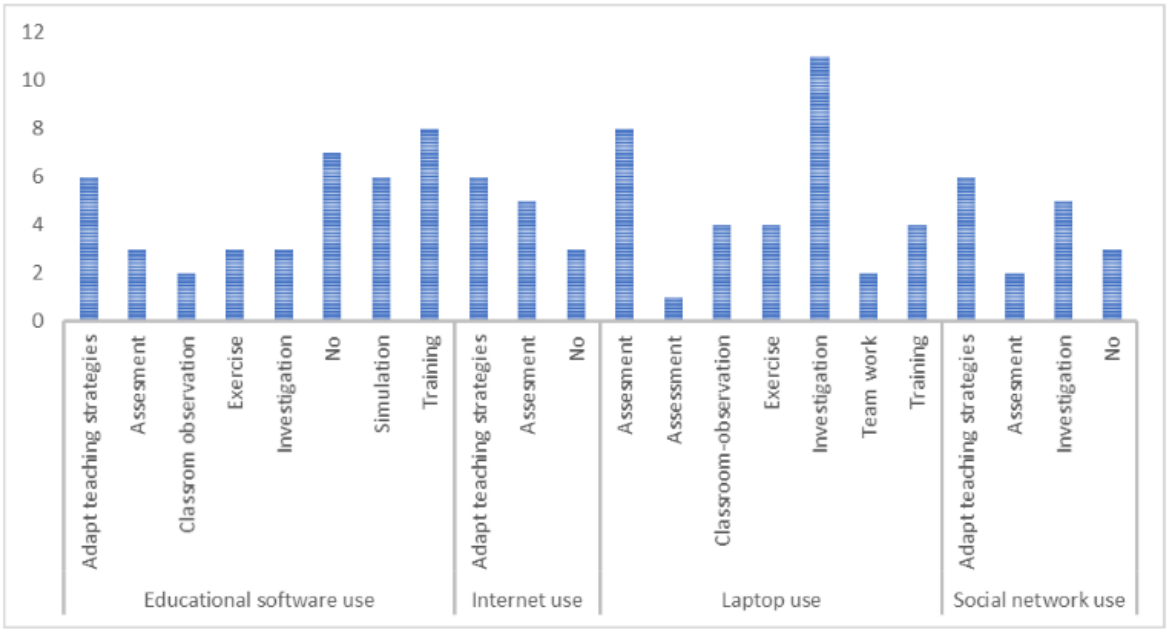

Figure 1. Synthesis of the well-defined three research phases (adapted from Ahmad et al., 2018; Kagesten et al., 2016)

Results of SWOT analysis

SWOT analysis was performed in order to assess the usefulness of new educational technologies by each category as can be seen in Figure 2.

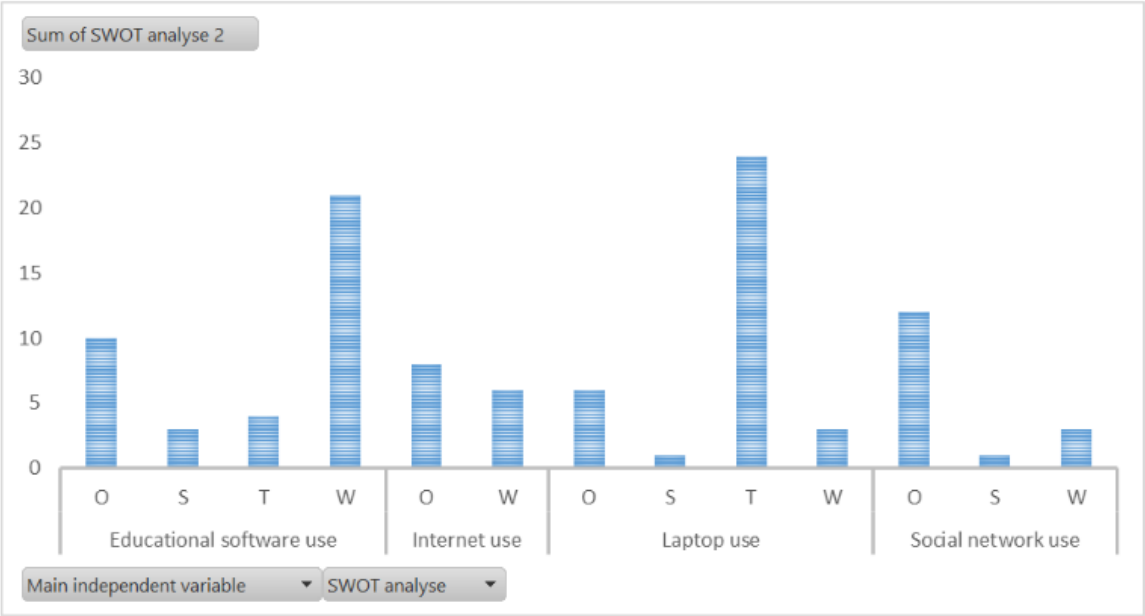

Figure 2. Overall SWOT analysis

Basically, the positive aspects of the use of the new educational instruments are less studied. The interest of the research is focused on the identification of the opportunities, but also on the identification of the weaknesses and threats associated with each such instrument. It is interesting to note the high frequency of the weaknesses identified in the case of the educational software and the threats associated with the use of laptops. In contrast to these two instruments, the case of the use of social networks and generally, the use of internet, the research is focused on the opportunities that can be developed.

To quantify more accurately the frequency of occurrence of all components of the SWOT analysis, a scale was used in our analysis, using the values of 1 for strengths; 2 for opportunities; 3 for weaknesses; and, 4 for threats. The scale makes a hierarchy starting with 1 for the most favourable aspect and ending with 4 for the less favourable.

To get distinct descriptive outcomes for each tool within our dataset the explore investigation using IBM SPSS Statistics 20.0 was performed and the results were presented in Table 3. The obtained results are in a good agreement with those presented in Figure 2, having also some supplementary information.

Table 3
Descriptive Statistics for Each Variable

Variable			Statistic	Standard error
Laptop use	Mean		3.09	.34
	95% confidence interval for mean	Lower bound	2.33	
		Upper bound	3.85	
	5% trimmed mean		3.16	
	Median		4.00	
	Variance		1.29	
	Standard deviation		1.14	
	Minimum		1	
	Maximum		4	
	Range		3	
	Interquartile range		2	
	Skewness		–.71	.66
	Kurtosis		–1.15	1.28
Laptop use	Mean		2.38	.22
	95% confidence interval for mean	Lower bound	1.90	
		Upper bound	2.85	
	5% trimmed mean		2.36	
	Median		2.50	
	Variance		.78	
	Standard deviation		.89	
	Minimum		1	
	Maximum		4	
	Range		3	
	Interquartile range		1	
	Skewness		–.23	.56
	Kurtosis		–.65	1.09

			Statistic	Standard error
Internet use	Mean		2.33	.21
	95% confidence interval for mean	Lower bound	1.79	
		Upper bound	2.88	
	5% trimmed mean		2.31	
	Median		2.00	
	Variance		.27	
	Standard deviation		.52	
	Minimum		2	
	Maximum		3	
	Range		1	
	Interquartiale range		1	
	Skewness		.97	.84
	Kurtosis		−1.88	1.74
			Statistic	Standard error
Social network	Mean		2.00	.19
	95% confidence interval for mean	Lower bound	1.55	
		Upper bound	2.45	
	5% trimmed mean		2.00	
	Median		2.00	
	Variance		.29	
	Standard deviation		.54	
	Minimum		1	
	Maximum		3	
	Range		2	
	Interquartiale range		0	
	Skewness		0	.75
	Kurtosis		3.50	1.49

Analysing the average values, medians and the confidence intervals is easy to notice that the use of the laptops is associated with the most negative aspects, with a mean value of 3.09, close to the upper negative limit, 4, and in the same time, with the larger dispersion of the results, with a 95% confidence interval between 2.33 and 3.85. The most positive perception is associated with the use of the Internet and social networks, somewhat surprising because usually the use of the social networks is not considered as a positive thing in terms of education.

CONCLUSION

An extensive literature review was conducted having as purpose the identification and analysis of strengths, weaknesses, opportunities and threats associated with the use of four modern instruments associated with the new information technologies used in education: laptops, educational software, internet, and social networks. If for the last three instruments, the positive and negative identified aspects are somehow balanced, for the use of laptops in the educational process, the negative aspects (mainly threats) clearly outweigh the positive features. Despite all critics publicly addressed to the social networks, their use in educational activities is associated with the most opportunities and strengths.

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