

Benefits and challenges of e-learning over approximately a decade

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Research Article

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Abstract

In the recent decade, e-learning has been immensely accepted and achieved great success in education. This study, aiming to identify the e-learning pedagogy in a recent decade, adopts the narrative literature review method via a comprehensive online database elicitation with English key words “e-learning, technology assisted learning, mobile learning, distance learning, ubiquitous learning, education, teacher”, and “instructor” to retrieve the literature examining e-learning. Through reviewing the publications in the recent decade and main research themes, the study explores the role of information technology literacy in e-learning, e-learning acceptance and effectiveness, e-learning outcomes, interactions in the e-learning context, adaptation to e-learning, motivation and enjoyment, e-learning devices, barriers to e-learning, and ineffectiveness of e-learning alone. Future research directions could focus on specific e-learning situations, e-learning readiness and adaptivity through interdisciplinary empirical studies.

Introduction

E-learning refers to an information technology integrated learning style, where both diachronous and synchronous learning are achieved using various kinds of information and technology tools (Lawn et al., 2017). In the e-learning situation, learners can access the course via online technologies, such as Internet, communicative tools and other information and communication technologies (ICT). The e-learning course is provided by teachers or instructors via the ICT. Learners can interact with peers or teachers through the online platform such as Learning Management System (LMS) (Black et al., 2007). They can also raise questions in corresponding sections such as discussion forum, feedback section, and question & answer. Teachers or instructors can access the target section to answer questions or solve difficult problems students came across. So do other learners who are committed to e-learning.

Many technical terms are used to describe e-learning, including technology assisted learning, mobile learning, distance learning and ubiquitous learning. In this study, e-learning is selected and operationally defined as a current learning approach which enables learners, teachers or instructors to learn and teach via an information technology supported mobile platform. Through the platform such as LMS (Black et al., 2007), learners, teachers and instructors can interact with each other and obtain considerable resources. Teachers and instructors can observe students' learning behavior and performances through LMS. Students can learn through LMS at any time or any place when or where they feel convenient.

Media of e-learning are of many varieties. It can be delivered synchronously or asynchronously through online platforms, mobile devices, or stable desktops. E-learning can even be realized through live shooting. It can then simultaneously reach learners throughout the world. Students' attendance and performances can easily be observed. Reminders can instantly arrive at those who are absent or perform poorly. Reminders will possibly encourage students to engage in autonomous learning, coupled with enhanced self-regulation.

Although the new century has been witnessing a large number of studies on e-learning effectiveness in education (e.g. Yu, 2020c; Bock, Kniha, Goloborodko, Lemos, Rittich, Mohlhenrich, Rafai, Holzle, & Modabber, 2021), determinants of e-learners' intention (Li, He, & Wong, 2021), and flexible and distributed programs (Aspeling, 2020), there are still some aspects remaining rarely explored. Examples are the e-learning readiness and adaptivity, as well as the trend of related publications in the recent decade. There are also inconsistencies in the findings of e-learning effectiveness although most of studies have acknowledged the effect of e-learning and supported the use of e-learning in education.

The study is guided by these research questions: (1) What is the trend of the number of e-learning publications in the recent decade? (2) What are main research themes? (3) What is the role of information technology literacy in e-learning? (4) Is e-learning accepted and effective? (5) What are e-learning outcomes? (6) What are the interactions in the e-learning context? (7) Are students or teachers adapted to e-learning? (8) What are motivation and enjoyment in e-learning? (9) What e-learning devices have been developed? (10) Are there any barriers to e-learning? (11) Is e-learning alone effective?

To answer these research questions, a systematic analysis of recent publications of e-learning is urgent to conduct. This study aims to systematically review recent works related to e-learning in order to answer these questions.

Literature review

Effectiveness in e-learning platform has been identified in various methods. In the 1980s effectiveness referred to a real operation of a platform, highlighting the technical issues (Rockart, 1982). A number of scholars, however, explored e-learning effectiveness in terms of platform quality (Yu, 2019), platform usage (e.g. Yu et al., 2018; Yu, 2018; Yu, & Yu, 2019), learner behavior, and satisfaction levels (Ives & Olson, 1984; Raymond, 1990). Through identification of satisfaction levels, the e-learning effectiveness was explored (Raymond, 1990).

Recently, a large number of studies have studied e-learning effectiveness in terms of platform quality, information quality, services quality, learner satisfaction, and perceived learner benefits (e.g. DeLone & McLean, 1992, 2003; DeLone, 1988). E-learning effectiveness is related to the acceptance (Yu, 2020a; Yu, 2020b) and frequent use of platforms at a post acceptance stage (DeLone & McLean, 1992). DeLone & McLean (1992) measured six dimensions of e-learning effectiveness: technology quality, information quality, technology use, learner satisfaction, individual impact, and organizational impact.

This six-dimensional model is mainly based on a planned behavior theory (Ajzen, 1991), which focused on the way attitudes and behavior exerted an influence on intention. The model accounted for the nature of learner behavior, where learners' behaviors were considered dependent on perceived behavior, normal conduct, learner intention. Information quality could be determined via completeness, timeliness, accuracy, relevance, and steadiness of information communication (Petter, DeLone, & McLean, 2012). The frequency of e-learning technology use was measured through the output of information, i.e. the actual times when learners accessed the e-learning system during a certain period of time. The

technology use also revealed the self-perception of e-learning (Urbach, Smolnik, & Riempp, 2010). Technology quality is the information platform processing and the technical adequacy.

Technology quality could be determined through technology function, ease of technology use, reliability, quality of data, portability of e-learning device, integration, importance, usability, availability, reliability, adaptability, and response time (Petter, DeLone, & McLean, 2012). Service quality is considered determinant to the platform usage, and also leads to learners' satisfaction.

The quality of e-learning focuses on the service supported by the e-learning system, personnel and institutes, which could be determined in terms of response time, communication, reliability and stability. The quality of e-learning service could identify the satisfaction and promote of the quality of interactions and communication (Pitt, Watson, & Kavan, 1995). When the quality of e-learning service was identified, learner expectations increased with the intense use frequency of e-learning technology (Conrath & Mignen, 1990).

Similar to other types of service, the e-learning quality was closely related to learners' technology use (DeLone & McLean, 2003). The theory of information technology used in education implied that the satisfaction with the information technology was an important dimension although they might not be significantly correlated (Igbaria, Zinatelli, & Cavaye, 1998). The e-learning effectiveness tends to be identified by variables related to use of the e-learning technology. Learners' satisfaction tends to be positively correlated with the frequency of use of the e-learning technology, which could be determined on the basis of learners' perception of the e-learning technology (Sun, Tsai, Finger, Chen, & Yeh, 2008). E-learning studies have been devoted to the acceptance of e-learning acceptance rather than advantages, disadvantages, influencing factors, trend of publications and e-learning devices.

Considering the insufficiency of the previous studies, this study aims to answer the aforementioned research questions, determining the recent trend of number of related publications, advantages and disadvantages in e-learning in terms of cognitive, affective, motivational effectiveness and academic achievements, the influencing factors of e-learning effectiveness, and e-learning devices and their effectiveness.

Research Methodology

This study adopts the narrative literature review method via a comprehensive online database elicitation with English key words "e-learning, technology-assisted, learning, mobile, distance, ubiquitous, education, teacher", and "instructor" to retrieve the literature examining e-learning. The online databases include SCIE, SSCI, A&HCI and CPCI.

An integrative literature review examined both advantages and disadvantages of e-learning in terms of cognitive, affective, motivational effectiveness and academic achievements for various fields, which involved studies adopting both qualitative and quantitative research methods in various fields. Publications ranged from January 2008 to January 2020 from selected online databases.

Content analysis method was further applied to organize and interpret the results. We retrieved 2230 articles from selected databases, with most subsequently excluded due to titles and abstracts. Some articles out of reputable databases such as SCI, SSCI, A&HCI were also excluded. The nature of the selected journals is of high quality and reputation. Many of them were out of the research scope, and merely 220 publications were related to the research theme. Therefore, 220 peer reviewed articles were examined, with approximately 180 excluded because they failed to meet the selection criteria, which are: (1) The selected publications should be peer reviewed journal articles; (2) The selected publications should be closely related to e-learning; (3) The selected publications should be the studies providing reliable data and convincing results, rather than pedagogical recommendations based on mere assumptions; and (4) The selected publications should be rigidly designed and scientifically explored based on either qualitative or quantitative research methods. Finally, 36 peer-reviewed articles (Appendix A) were included in this review. Major themes emerged from the content analysis: advantages and disadvantages in terms of cognitive, affective, motivational effectiveness and academic achievements, influencing factors of e-learning in education including information technology literacy, motivation, enjoyment, and correlations. These themes exposed substantial heterogeneity in instructional design and other elements of e-learning applied to education.

Results

After carefully reading and analyzing the selected publications, we found that e-learning studies on medical education significantly outnumbered (N=15/36) those in other areas. We therefore arrived at some conclusions firstly regarding medical education, followed by other areas, which will be presented according to the sequence of proposed research questions.

Main research themes

We obtained 1885 results in Science Citation Index, Social Science Citations Index, and Arts & Humanities Citation Index, using e-learning as the title, ranging from 1980 to 2020. Via VOSviewer concurrence analysis, we obtained nine clusters, i.e. main research themes (Figure 1).

Cluster 1 includes 81 items, e.g. Accuracy, acquisition, adolescents, blended learning, competence, computers, continuing education, curriculum, and education, etc. Cluster 2 includes 78 items, e.g. adaptation, adaptive e-learning, anxiety, collaboration, cluster analysis, courseware, data mining, e-learning environment and educational data mining, etc. Cluster 3 includes 69 items, e.g. acceptance, adoption, antecedents, continuance intention, e-learning system, ease, gender, intention, perceived ease, social cognitive theory, and workplace, etc. Cluster 4 includes 43 items, e.g. active learning, cloud computing, communication, computer-assisted instruction, games, higher education, innovation, m-learning, online learning, social presence, support, virtual-reality, and web 2.0, etc.

Cluster 5 includes 41 items, e.g. achievement, classroom, distance education, effectiveness, engagement, formative assessment, experiences, motivation, quality assurance, self-regulated learning, student satisfaction, training, and trends, etc. Cluster 6 includes 34 items, e.g. accessibility, adult learning,

distributed learning, engineering education, human-computer interaction, improving classroom teaching, teaching/learning strategies, and technologies, etc. Cluster 7 includes 18 items, e.g. barriers, beliefs, efficacy, knowledge management, self-determination theory, and tools, etc. Cluster 8 includes 5 items, i.e. knowledge sharing, management, participation, virtual communities and work. Cluster 9 includes 3 items, i.e. authoring tools, experience, and integration.

Information technology literacy

Information technology literacy was strongly correlated with use of information technology devices, exploitation of online databases and exploration of online information. It is thus important for universities to recruit professional with high information technology literacy in order to train digital talents and maintain digital programs. Students' digital exposure could encourage but not force them to improve digital literacy and skills (Rafi, Zheng, & Ahmad, 2019).

Although it has been demonstrated by numerous studies that e-learning is effective in education, there are still numerous factors that may influence its effectiveness. Effects of e-learning on nursing education are under great influence of differences in information technology literacy of both students and teachers. High literacy of information technology may facilitate the achievements of e-learning in nursing education (Button et al., 2014). Lower literacy of information technology may, however, weaken its effectiveness.

It is thus necessary to connect the educational institute to the society and to develop the digital literacy of teachers and students by enhancing collaborative learning and teaching, as well as mutual cooperation and communication. Digital literacy could not develop without control over digital ethics in educational practice (Domingo-Coscollola, Bosco, Segovia, & Valero, 2020). eHealth literacy was closely related to use of Internet. Use of Internet was closely related to age, ethnicity, education, economic status, computer characteristics, marital status, health literacy, medical decision making, and health information sources, rather than health status (Arcury et al., 2020).

E-learning acceptance and effectiveness

In the information age, innovation of knowledge is leading to the acceptance of e-learning, breaking the limitations of time and space. Most English learners consider e-learning significantly more convenient and helpful than the traditional learning (Tan, 2015). In general, most studies supported e-learning education since they revealed significantly higher acceptance and effectiveness compared with traditional learning. Many studies have recently discussed acceptance and effectiveness of e-learning in many fields. E-learning has become increasingly popular in nursing and healthy profession. Since the transformation of hospital training to e-training, e-learning has emerged as the most significant change in nursing education (Button, 2014). It was also demonstrated that e-learning, which met certain quality criteria, could achieve cognitive, affective and psychomotor learning goals as effectively as the traditional learning approach (Koch, 2014). E-learning has also been widely used and accepted in children's care training work.

Assisted with the International Children's Palliative Care Network, most (>80%) e-learning participants reported that e-learning courses were clearly presented, easily understood, highly rated and particularly beneficial. Some (75%) learners reported that e-learning could enhance knowledge, improve skills and cultivate positive attitudes although only 61% learners reported a significant change in learning practice. This e-learning network is an innovative approach of knowledge acquisition, by which learning contents are easily accessible and available to learners (Daniels & Downing, 2018). Use of e-learning in medical education could facilitate adult learning theory, where educators would improve learning effectiveness (Ruiz et al., 2006).

The integration of e-learning into traditional learning proves acceptable and effective. After adaptation to e-learning contexts, e-learning integrated into pedagogical approaches and teaching strategies is beneficial to nurses who are in need of continuous education, which equips nurses with continuous learning skills and safe evidence based care (Button et al., 2014). Although e-learning has received great positive comments, it can hardly replace the traditional approach completely. Situated e-learning could effectively improve nursing education although the cognitive ability was not significantly enhanced under the e-learning model compared with traditional learning. E-learning can therefore be considered an effective aid to traditional learning in nursing education (Feng et al., 2013). Nevertheless, there has been no enough evidence demonstrating that e-learning can completely substitute the traditional pedagogical approach.

The similar effect of e-learning was revealed on health education. Similar to traditional learning, e-learning can achieve success in health professional training. E-learning may provide special training, practices and self-management support for patients, which may not be realized through traditional learning alone. The effect of e-learning on self-management support is a relatively new field with sparse studies exploring characteristics of e-learning support for self-management (Lawn et al., 2017). The effect of e-learning on self-management is, therefore, in need of further explorations.

E-learning tools have been used in so many fields that they are of great significance to education and training. E-learning is able to provide indisputable benefits for learners in terms of evaluation and knowledge delivery. The different effectiveness of e-learning was mainly due to choice of appropriate e-learning platform, learning contents, and e-learning user friendliness. A multilingual medium is an important feature for an e-learning platform to deliver the learning contents to a wide range of learners.

E-learning outcomes

E-learning could improve learning outcomes, e.g. self-regulation, learner satisfaction, flexible and speedy learning. It could also meet various learning needs, facilitate cooperation among learners, save time and costs, reach multiple learners, stimulate mutual learning and teaching, obtain instant feedback, access plentiful resources, and lessen environmental pollution. Generally, e-learning approach could exert a positive influence on education on the basis of necessary grounds (Somayeh et al., 2016).

In language education, e-learning also received positive feedback. Commercial e-learning courseware has been immensely accepted in Japan, which could be used to improve students' English proficiency. The courseware could be used to evaluate learning progress and enhance students' concentration on learning. The usefulness of courseware is closely related with students' previous learning experiences (Hirata, 2018). Those who have experienced e-learning performed significantly better than those who have not.

The blended English language e-learning approach produced positive learning outcomes in Islamic higher education. Combination of face-to-face with online e-learning could enhance motivation and collaboration of learners although no significant differences were found in test results (Yauri et al., 2016). E-learning could improve English learners' academic achievements, enhance their self-regulation, and create a relaxing learning environment to reduce learners' anxiety and stress (Shahi, 2016). E-learning strategies could improve language course management, better learning outcomes, and enhance learner self-regulation (Milliner & Cote, 2016).

Regulated e-learning situation could lead to positive learning outcomes. Regulation plays an important role in the e-learning context. Highly regulated e-learning model could lead to significantly better learning outcomes and academic achievements than the non-regulated (Goda et al., 2015). The e-learning model, which requires strong regulation, has been widely accepted in both academic and business areas due to its easy accessibility, reasonable price and resourceful contents (Laisi et al., 2011). Although the new decade has been witnessing various advantages of e-learning, we cannot ignore its barriers.

Interactions in the e-learning context

Interactions may be negatively influenced in the e-learning situation in many fields. The self-regulated and asynchronous nature of e-learning may decrease the interactions between learners, peers and teachers (Koch, 2014). The decrease in the interactions may cause ineffectiveness in e-learning, which should be considered in learning and teaching designs.

Interactions of factors such as sense of community, learner satisfaction, and perceived cognition could also significantly influence the effectiveness of e-learning. In the e-learning settings, sense of community is closely correlated with learner satisfaction and the latter is also strongly correlated with learner perceived cognitive learning. The perceived cognitive learning is strongly correlated with the interaction between learners and learning contents, while weakly correlated with the interaction between learners and instructors and moderately correlated with the interaction between learners. It is indispensable to deal with the interactions in the e-learning contexts so that the e-learning effectiveness may be augmented (Baturay, 2011).

Adaptation to e-learning

It is very important to obtain cooperation from both students and teachers. Due to the technological innovation and human curiosity, students may be ready to adapt to a new pedagogical approach, while teachers, who have been teaching for many years based on a stereotypical method, may refuse any

change because the new teaching method will cost them more efforts than the traditional one. Academic staff tend to resist adapting to the unfamiliar e-learning strategies (Black, Beck, Dawson, Jinks & DiPietro, 2007), because it is most likely that they would like to spend more efforts engaging academic research instead of a new trial of e-learning. They would prefer the familiar effort-saving traditional pedagogy to the unfamiliar effort-consuming e-style. It is thus meaningful for e-learning technology designers to carefully take into account how to save teachers' efforts to accept the new pedagogy.

In addition, it is too early to conclude that all the teachers and learners are skillful in technology use. Thus, merely ongoing e-learning training may be insufficient and completely replacing teachers with e-learning technologies may prove unrealistic. Technology adaptation and social context should be considered in order to familiarize students and teachers with use of e-learning technologies. A scaffolding approach may be helpful to the development of e-learning expertise. The minimum entrance requirements for e-learning may be necessary to include (Bharuthram & Kies, 2013). It is also important for designers to make the e-learning technology playful, useful and easy in the learning and teaching process. In this way, those who are unfamiliar with the technology will possibly spend some time trying it.

As a new learning approach, e-learning is also confronted with many cultural challenges (Laisi et al., 2011), which is hard for learners and teachers to adapt to. In a culture where educational technology is not supported, it may be hard to implement e-learning device assisted learning and teaching. On the other hand, in a culture where information technology is encouraged and immensely popular, e-learning would most likely be accepted and developed, coupled with its higher effectiveness. On condition that the educational institute has a strong academic culture, the e-learning atmosphere will be more easily cultivated than the one without a strong academic culture.

Motivation and enjoyment

The form of e-learning alone without help of teachers or instructors may discourage students from learning, due to which students' motivation may be dampened. The perceived teacher online and offline support exerted a direct and mediated effect on learners' e-learning motivation. Effort beliefs consistently predicted task value and ability beliefs, and ability beliefs predicted e-learning task fulfillment (Fryer & Bovee, 2016). Briefly, the perceived teacher online and offline support, effort beliefs, task value and ability belief are all considered influencing factors, which should be taken into account when e-learning is included in teaching and learning design.

Vocabulary learning is an important element in language acquisition. The vocabulary acquisition was positively influenced by educational game-assisted e-learning enjoyment, which could motivate learners to continue the long-term learning process. Enjoyment of the educational game might be an important factor that could determine the effectiveness of vocabulary e-learning (Ebrahimzadeh & Alavi, 2016). It is therefore indispensable that educational games involve the element of enjoyment when designed.

E-learning devices

Numerous e-learning devices have been developed and applied to education, among which those used in language acquisition were huge in number. Below are merely recent e-learning devices retrieved from a limited number of databases, coupled with their specifically demonstrated effectiveness in education.

Educational Broadcasting Service. It is noteworthy that numerous e-learning devices were developed to assist language acquisition and obtained significantly better learning outcomes than traditional pedagogy. Learners felt satisfied with the blended e-learning model, via which they showed positive continuance intention to learn English (Lin et al., 2016). Consistent use of video-based e-learning (i.e. Educational Broadcasting Service: EBS) led to changes in high school students' English proficiency mediated by behavior control strategies, which precluded the decrease of English proficiency possibly due to the time management function of EBS (Chae, 2018). Another e-learning medium, i.e. Moodle platform, has been demonstrated able to improve German communicative competence of students majoring in tourism management. Integrated with modern pedagogical conceptions and second language teaching strategies, this e-learning platform could effectively complete innovative and professional tasks (Bihych & Okopna, 2018).

MyEVA and EED. An e-learning tool, MyEVA, was made of three modes: MyEVA in preference mode, MyEVA in basic mode, an Internet dictionary and a traditional acquisition mode. It could greatly improve vocabulary learning and prolong the retention of second language vocabulary on the basis of mixed modes (Yang & Wu, 2015). In online e-learning English for Educational Development (EED) course, both advantages and disadvantage of e-learning were explored. The technology assisted e-learning was flexible and the integrated discussion forum was useful for practitioners who were to join or joined the e-learning model (Bharuthram & Kies, 2013).

WebCT and IPHRAS. An e-learning platform, WebCT, was designed by two European universities: the London School of Economics (United Kingdom) and the University of Valencia (Spain) to improve language learning and information exchange between both universities. It was reported that the student participation in the platform was strongly correlated with the final qualifications, and the e-learning platform positively contributed to learning and teaching in both English and Spanish languages (Cuadrado et al., 2009). An innovative e-learning platform–IPHRAS: Interphraseologie for Studien-und Berufsmobile was developed to incorporate theme-based words in multilingual forms including Greek, Turkish, Romanian, and Bulgarian into more popularly used languages such as English and German. More importantly, this platform contained idiomatic expression, carried cultural concepts, and included endangered languages (Teodora et al., 2017).

An on-line bulletin board and GBWI. It was also demonstrated that e-learning devices could improve English writing skills. An e-learning tool, actually an on-line bulletin board, was demonstrated more beneficial to academic writing compared with traditional face-to-face communication (Ferriman, 2013). An e-learning tool–Genre-based Writing Instructions (GBWI) was developed to cultivate learners' English academic writing skills, which proved useful and helpful to learners. Learners' skills in handling e-learning tools were also improved during the process of using GBWI (Lin et al., 2017). In an e-learning technology

assisted course, students achieved significantly more success in English rhetoric use in academic writing, and reached a significantly higher level of performance than those without e-learning support. The e-learning platform could also help students to analyze culturally different rhetorical styles and the e-learning platform assisted interactions could also improve international students' academic writing skills (Xing et al., 2008).

An e-learning module. Besides those used in language acquisition, a large number of e-learning devices in medical education were also developed. An e-learning module was designed to interpret the medical interview between medical students and patients, which enhanced students' self-efficacy during the professional interpretation and produced a significantly higher gain on knowledge for students. This e-learning tool might help medical professionals to overcome language barriers and thus improve healthcare services for patients who have difficulty in linguistic communication (Ikram et al., 2015).

An e-learning course and platform. An e-learning course was designed to train medical postgraduate students in English, Spanish, German and Hungarian across five countries in Europe, where a significant gain in knowledge scores was found in acquisition, appraisal, application and implementation. Learners felt confident that through the e-learning platform, they could easily assess research evidence and that the clinical effectiveness of the healthcare system should be evaluated. E-learning could effectively assist learning and teaching in different languages, educational environments and clinical specialties (Kulier et al., 2008).

eGender Platform. An e-learning platform, i.e. eGender Platform, was designed for learners to acquire the knowledge of Sex and Gender Medicine. The most frequently visited module was "Gender Medicine-Basics", where the discussion forum was the most attractive section. This e-learning platform proved a flexible and user-friendly knowledge sharing medium, which provided highly qualified learning contents for learners and met the requirements of higher education especially in the pursuit of accredited Master of Public Health at Charite-Berlin (Seeland et al., 2016).

The FAO/INFOODS e-Learning Course. The FAO/INFOODS e-Learning Course on Food Composition Data was designed to deliver food composition knowledge to food professionals, which included fundamental knowledge of food composition, and provided comprehensive and interactive knowledge for learners. Learners held positive attitudes to this cost-effective and widely accepted e-learning platform (Charrondiere et al., 2016).

Commonwealth of Learning. The branch of e-learning platform of the Commonwealth of Learning's (COL), i.e. International Organisations (eLIO) section, was demonstrated to have successfully constructed a distance learning approach, which satisfied most participants. Specifically, more than 2000 learners showed their satisfaction with this e-learning platform, cooperating with 8 globalized institutes, reaching a high female participation rate (62%) and graduation rate (75%) in the online courses (McGreal, 2009).

Personalized Learning Course Planner. An e-learning platform, named a Personalized Learning Course Planner (PLCP) allowed learners to select learning contents on their own, which resulted in satisfactory

learning outcomes based on the data collected from test scores after the study. The platform also improved learning effectiveness and enhanced learner satisfaction (Jeong et al., 2012).

Other e-learning tools and platforms. The e-learning tools such as Master's Binary Schema (Master 1988, 2003), explicit instruction, chunking, and direct feedback were significantly more effective than traditional pedagogical techniques in English learning and teaching of articles and grammatical structures (Gillian & Lew, 2018). Learners assisted with the e-learning platform, i.e. an Adaptive Learning in Teaching English as a Second Language performed significantly better than those who learned without the aid of e-learning platform in second language acquisition (Wang & Liao, 2011). Additionally, learners' attitudes were explored towards an e-learning platform named Learn English Pathways. The e-learning platform could not only positively influence learners' global attitudes toward English language learning but also improve their English language proficiency and enhance their self-regulation (Aladl, 2016).

Barriers to e-learning

Despite that the blended e-learning approach could enhance learners' perceptions of and confidence in End of Life Care, there were still numerous barriers to e-learning implementation such as passive participation, lack of new insights dissemination, knowledge within homes and other organizational and inter-professional resistance (Farrington, 2014). Overcoming these barriers would possibly play a positive role in improving learning effectiveness. Barriers to face-to-face interactions between patients and medical workers are also an important element to negatively influence e-learning effectiveness.

E-learning could possibly lead to barriers to face-to-face interactions between patients and medical workers. Traditional didactic nursing education limited learner-patient interaction to physical situation, while e-learning could enhance knowledge acquisition and skill improvements through extending interaction to online activities. Healthcare providers who interact with virtual patients in designed situations may avoid unnecessary risks and encounters with real patients. However, the effectiveness of situated e-learning is inconsistent (Feng et al., 2013) in that patient and nurses could not implement face-to-face interaction and communication, which could cause many misunderstandings. As for care and assurance, this physical interaction and communication is superior to virtual situation. In this case, it may be reasonable to integrate e-learning into traditional learning in medical education.

Ineffectiveness of e-learning alone

E-learning alone might not be effective enough to achieve success in the training of nursing. Combination of e-learning with traditional learning was strongly suggested because very few e-learning models could independently achieve success in high interactivity, reflection, practice and application to practice for health professionals who learned how to deliver SMS effectively. This indicates that there is still much room to understand about how best to deliver e-learning for SMS skills development. It was also suggested that the way to implement health professional training regarding SMS delivery was important for the patients under chronic conditions in order to provide partnership, and human-oriented care (Lawn

et al., 2017). It may be too hasty to draw a conclusion that e-learning is effective in all aspects in medical education.

Despite the fact that e-learning is a flexible approach, face-to-face patient simulation is superior to e-learning alone, which is especially true when nursing evaluation is not scalar. Although e-learning may bring positive results to nursing education, combination with other forms of approaches may be a wise decision to augment the e-learning effectiveness in teaching and learning. Integration of e-learning into traditional pedagogical approach will most likely prove a really effective and highly efficient learning approach (McDonald et al., 2018). In e-learning contexts, there were no significantly correlations between visual learning style, auditory learning style, kinesthetic learning style, read/write learning style and students' English achievement among Moroccan university students, although the e-learning style could improve students' academic achievements of English language (Azize, 2017).

Discussion

It can be inferred from the above reviews that in approximately the recent decade, e-learning has undoubtedly been accepted and achieved great success in education although there are still controversies. When designing e-learning pedagogy, we should make every effort to cope with such issues as technological costs, e-learning readiness, and e-learning awareness.

Technological costs

The e-learning situation needs technological support such as wireless connection, computers, maintenance of equipment, mobile devices, and other related technological infrastructure. This needs a large sum of funds, which may pose as a threat to teachers, learners and institutes. For teachers and students, they have to spend some time and money learning the new technological skills and e-learning operations. For institutes, e-learning equipment will undoubtedly be a financial burden. In order to improve e-learning effectiveness, these financial concerns must be considered. Teachers will possibly voluntarily engage in e-learning pedagogy in case that the e-learning model can save their time and financial costs, release their workload and improve their teaching effectiveness. Most students will be willing to accept the new e-learning style if they feel the e-learning model is cheap, easy, useful, enjoyable and effective.

E-learning readiness

The effectiveness of e-learning heavily depends on e-learning readiness. On condition that learners are not ready to receive e-learning pedagogy, it is hard to implement the e-learning model efficiently and effectively. Rather, if learners are ready to receive this new learning style, the effectiveness and efficiency will be easy to be stimulated and maintained. Senior students possessed significantly more e-learning readiness than freshmen. Students had significantly less e-learning readiness in faculties of Primary Mathematics Education, Mathematics Education, Preschool Education, Psychological Counseling and Guidance, and Primary Education than those in faculties of German Language Teaching, Computer Education and Instructional Technology, Science Education, Physics Education, French Language

Teaching, English Language Teaching, and Chemistry Education (Yurdugul & Demir, 2017). E-learning readiness is a deeply hidden psychological status, which is hard to reveal and explore. Much research needs to be conducted regarding e-learning readiness.

E-learning awareness

The awareness of e-learning is also an important factor that needs our pondering. Those who are strongly aware of the e-learning tend to accept the e-style, while those who are weakly aware of the e-learning tend to resist it. Weak awareness of English language e-learning was revealed, where females held significantly stronger awareness than males. After application of the e-learning program, English language learning awareness was significantly enhanced compared with before the program was applied. It was thus recommended that in order to improve e-learning effectiveness, pilot awareness programs and e-learning training seminars be held before the e-learning was formally implemented (Soliman & Waziry, 2017). Therefore, it is necessary for e-learning device designers to integrate the corresponding elements into e-learning devices that can enhance the e-learning awareness. It is important to immerse both students and teachers in e-learning settings, which is helpful to the enhancement of e-learning awareness.

Barriers to e-learning are of many kinds. Older teachers and learners may prefer traditional pedagogy to the new e-style, while the younger may prefer the new one. High costs of e-learning devices will possibly hinder the acceptance of e-learning. Difficulty in use of e-learning will most likely discourage teachers and learners. Lower efficiency and poor effectiveness will doubtlessly decrease the desire to use e-learning tools. Future designs of e-learning pedagogy should take into account all of these elements.

Finally, there have been far more literature review studies on e-learning effect than empirical research in medical education (e.g. Daniels & Downing, 2018; McDonald et al., 2018; Voutilainen et al., 2017; Koch, 2014), which might have led to unreliable results. Future research into e-learning effectiveness in medical education might shed more light on empirical studies.

Conclusion

This study, limited to publications retrieved from “Web of Science”, cannot include all the publications in all languages across the world. The year periods could also be regarded as a limitation. In the future, publications from more databases and in more languages could be included. Furthermore, we could develop more advanced technologies that would most likely make e-learning more colorful and acceptable, together with the altered role of teachers. An adaptive e-learning model could be designed to provide personalized learning for individual students, where adaptivity was deemed as the e-learning function to adapt to individually various levels of knowledge and different features (Bradac & Walek, 2017). Future development of e-learning devices could seriously take adaptivity into account.

In the e-learning context, the teacher does not play the same role as in the traditional role. How to define the role of teacher in e-learning is an issue waiting to be addressed (Koch, 2014). Furthermore, e-learning

readiness is one of the indispensable factors influencing the effectiveness of e-learning since it directly exerts a great influence on e-learning motivation. Future research could therefore focus on how to improve e-learning readiness for both learners and teachers (Yurdugul & Demir, 2017) through interdisciplinary cooperation. Empirical studies other than meta-analysis could be applied to future research into e-learning (Voutilainen et al., 2017).

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Appendix

Appendix A: Peer-reviewed articles used in this study

N	Author and year	Major Findings	Journal
1	Arcury et al. (2020)	Use of Internet was closely related to age, ethnicity, education, economic status, computer characteristics, marital status, health literacy, medical decision making, and health information sources, rather than health status.	<i>Journal of Applied Gerontology</i>
2	Aladl, A. E. (2016)	The e-learning platform could not only positively influence learners' global attitudes toward English language learning but also improve their English language proficiency and enhance their self-regulation.	<i>Arab World English Journal</i>
3	Baturay, M. H. (2011)	Sense of community, learner satisfaction, perceived cognition and interaction could influence the effectiveness of e-learning.	<i>Interactive Learning Environments</i>
4	Bharuthram, S., & Kies, C. (2013)	A scaffolding approach may be helpful to the development of e-learning expertise.	<i>British Journal of Educational Technology</i>
5	Black et al. (2007)	Academic staff tend to resist adapting to the unfamiliar e-learning strategies.	<i>TechTrends: Linking Research and Practice to Improve Learning</i>
6	Button, D., Harrington, A., & Belan, I. (2014)	E-learning has emerged as the most significant change in nursing education.	<i>Nurse Education Today</i>
7	Chae, S. E. (2018)	Consistent use of Educational Broadcasting Service precluded the decrease of English proficiency.	<i>Journal of Asia TEFL</i>
8	Conrath, D. W., & Mignen, O. P. (1990)	When the quality of e-learning service was identified, learner expectations increased with the intense frequency of e-learning technology.	<i>Information & Management</i>
9	DeLone, W. H., & McLean, E. R. (2003)	Similar to other types of service, the e-learning quality was closely related to learners' technology use.	<i>Journal of Management Information Systems</i>
10	Ebrahimzadeh, M., & Alavi, S. (2016)	Enjoyment of the educational game might be an important factor that could determine the effectiveness of vocabulary e-learning.	<i>Cogent Education</i>
11	Feng, J.Y., Chang, Y.T., & Chang, H.Y. (2013)	The effectiveness of situated e-learning is inconsistent in that patient and nurses could not implement face-to-face interaction and communication.	<i>World Views on Evidence-based Nursing</i>
12	Ferriman, N. (2013)	E-learning devices could improve English writing skills.	<i>Computers & Education</i>
13	Fryer, L. K., & Bovee, H. N. (2016)	Effort beliefs predicted task value and ability beliefs; ability beliefs predicted e-learning task fulfillment.	<i>Internet and Higher Education</i>
14	Goda, Y., Yamada, M., & Kato, H. (2015)	Highly regulated e-learning model could lead to significantly higher effectiveness and better academic achievements than the non-regulated.	<i>Learning and Individual Differences</i>
15	Ikram, U. Z., Essink-Bot, M. L., & Suurmond, J. (2015)	The e-learning tool might help medical professionals to overcome language barriers and thus improve healthcare services for patients who have difficulty in linguistic communication.	<i>Medical Teacher</i>
16	Jeong, H.Y., Choi, C.R., & Song, Y.J. (2012)	The e-platform also improved learning effectiveness and enhanced learner satisfaction.	<i>Expert Systems with Applications</i>
17	Koch, L. F. (2014)	The self-regulated and asynchronous nature of e-learning may decrease the interactions between learners, peers and teachers.	<i>Nurse Education Today</i>
18	Kulier, R., Hadley, J., & Weinbrenner, S. (2008)	E-learning could effectively assist learning and teaching in different languages, educational environments and clinical specialties.	<i>BMC Medical Education</i>
19	Lawn, S., Zhi, X., & Morello, A. (2017)	The way to implement health professional training regarding SMS delivery was important for the patients under chronic conditions in order to provide partnership, and human-oriented care.	<i>BMC Medical Education</i>
20	Lin, C.C., Liu,	Learners' skills in handling e-learning tools were also improved during	<i>Educational</i>

	G.Z., & Wang, T.I. (2017)	the process of using Genre-based Writing Instructions.	<i>Technology & Society International Review of Research in Open and Distance Learning Nurse Education Today</i>
21	McGreal, R. (2009)	Commonwealth of Learning (an e-learning platform) could successfully construct a distance learning approach, which satisfied most participants.	
22	McDonald, E. W., Boulton, J. L., & Davis, J. L. (2018)	There have been far more literature review studies on e-learning effect than empirical research in medical education	
23	Petter, S., DeLone, W., & McLean, E. R. (2012)	Technology quality could be determined through technology function, ease of technology use, reliability, quality of data, portability of e-learning device, integration, importance, usability, availability, reliability, adaptability, and response time.	<i>Journal of the Association for Information Systems</i>
24	Pitt, L. F., Watson, R. T., & Kavan, C. B. (1995)	The quality of e-learning service could identify the satisfaction and promote of the quality of interactions and communication.	<i>MIS Quarterly</i>
25	Rafi, M., Zheng, J.M., & Ahmad, K. (2019)	Students' digital exposure could encourage but not force them to improve digital literacy and skills.	<i>Information Discovery and Delivery</i>
26	Ruiz et al. (2006)	Use of e-learning in medical education could facilitate adult learning theory, where educators would improve learning effectiveness.	<i>Academic Medicine</i>
27	Seeland, U., Nauman, A. T., & Cornelis, A. (2016)	The e-learning platform proved a flexible and user-friendly knowledge sharing medium.	<i>Biology of Sex Differences</i>
28	Sun et al. (2008)	Learners' satisfaction tends to be positively correlated with the frequency of use of the e-learning technology.	<i>Computers & Education</i>
29	Voutilainen et al. (2017)	The effect of e-learning in nursing is strongly dependent on specific situations.	<i>Nurse Education Today</i>
30	Xing, M., Wang, J., & Spencer, K. (2008)	The e-learning platform could also help students to analyze culturally different rhetorical styles and improved overseas students' academic writing skills.	<i>Language Learning & Technology</i>
31	Yang, F.C.O., & Wu, W.C.V. (2015)	MyEVA (an e-learning tool) could greatly improve vocabulary learning and prolong the retention of second language vocabulary.	<i>Educational Technology & Society</i>
32	Yauri et al. (2016)	Combination of face-to-face with online e-learning could enhance motivation and collaboration.	<i>Arab World English Journal</i>
33	Yu, Z., & Yu, X. (2019)	A number of scholars, however, explored e-learning effectiveness in terms of platform usage.	<i>Computer Applications in Engineering Education</i>
34	Yu, Z. (2020)	E-learning effectiveness is related to the acceptance.	<i>Journal of Information Technology Research</i>
35	Yurdugul, H., & Demir, O. (2017)	Future research could therefore focus on how to improve e-learning readiness for both learners and teachers.	<i>Hacettepe University Journal of Education</i>
36	Li, C.M., He, L.M., & Wong, I.A. (2021)	Determinants of e-learners' behavioral intention	<i>Education and information technologies</i>

Competing Interests

The authors declare no competing interests.

Figures

