Article

E-learning, M-learning and D-learning: Conceptual definition and comparative analysis

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Abstract

In the 21st century, the information and communication technology explosion increases the uses of digital devices for many purposes in the world of work and in formal and non-formal education. This study analyzes existing literature on the basis of the definition of the concepts, terminology used, differences, fundamental perspectives, benefits, disadvantages, and finally the similarities and differences of the e-learning (electronic learning), m-learning (mobile learning), and d-learning (digital learning). It reveals that e-learning and m-learning are subsets of d-learning. On the other hand, some learning tools could be considered as m-learning as well as e-learning.

Introduction

In the 21st century, technology is playing a crucial role in our daily lives and it calls professionals, educators, and learners reflect again over their basic beliefs in order to use technology for the re-design or re-engineering of education and training system. In addition, these technological devices play a significant role to help learners and teachers to get more advantages from it. However, the terms of electronic learning (e-learning), mobile learning (m-learning), and the digital learning (d-learning) are used indifferently or in a complementary way to mean technological learning. E-learning is the alternative of traditional education and it can also be a complementary to it. On the other hand, the m-learning is the complementary of both traditional learning as well as e-learning. M-learning

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allows learners to interact with their learning resources when they are far away from their normal place of learning environments (Clark, 2007). Through the m-learning, students can easily buy e-books and they can download to their devices (Geist, 2011) and it is no longer a novelty for learners, but "it is a mainstream, pervasive learning delivery medium relied upon by thousands of post-secondary education institutions and millions of workforce" (Cherian and Williams, 2008). M-learning is the subset of e-learning and the e-learning is a macro concept and it includes the mobile learning as well as online environments. Quinn (2000: 1 of 4) pointed that "M-learning is e-learning through mobile computational devices: Palms, Windows CE machines, even your digital cell phone." D-learning is a tool which addresses a numerous of challenges that are faced by educational institutions, community leaders as well as by the policymakers and it helps learners to connect in the remote areas "with high quality college – and career-prep courses taught by a highly qualified teacher who does not work inside their school building". In addition, the d-learning can also be very helpful for instructors in fact who is facing a lot of barriers in order to meet student's needs (Digital Learning, 2011). And uses of these technical terms sometimes confuse users with the concepts of online learning or e-learning, m-learning, and the d-learning encompasses. This paper will clearly encompass the aforementioned concepts. Firstly, it presents the conceptual elements and methodology of the study. Secondly, it presents the conceptual definition of e-learning, m-learning, and d-learning. Finally, it analyzes the terminology used in e-learning, m-learning, and d-learning in order to present in the subsequent parts the comparison between them and in then also presents the advantages and disadvantages of e-learning, m-learning, and d-learning.

The significance of the study

How to select appropriate teaching and learning scenario and techniques? The rise of the online technology learning stimulates many ways of learning. But a bit of confusion remains when comes time to name the different technological ways of learning. E-learning, m-learning, and d-learning stimulated in this digital uses for learning are not always used correctly where they overlap. The similarities and differences between e-learning, m-learning, and d-learning should be clarified for teachers, researchers, trainers, learners, etc. to solve educational and learning issues and improve educational outcome that are associated with the current real life situation.

Conceptual elements and methodology of the study

Research questions

The following research questions were taken into consideration:

 (i) What is meant by e-learning, m-learning, and d-learning?
(ii) What are the differences, similarities, advantages, disadvantages, and terminology used in e-learning, m-learning, and d-learning?

The aim, objective, and sub-objectives

The aim of this study is to shed light on the e-learning, m-learning, and d-learning. To achieve the aim, the following objective is considered:

Objective:

- To analyze the concept and the fundamental perspectives of e-learning, m-learning, and d-learning.

In order to achieve the objective the following sub-objectives were taken into consideration:

- Sub-objective 1: Analyze the terminology used and differences in e-learning, m-learning, and d-learning.
- Sub-objective 2: Analyze the conceptual definitions of e-learning, m-learning, and d-learning.
- Sub-objective 3: Analyze the fundamental perspectives of e-learning, m-learning, and d-learning.
- Sub-objective 4: Examine the similarities and differences between e-learning, m-learning, and d-learning.
- Sub-objective 5: Compare the benefits and disadvantages of e-learning, m-learning, and d-learning.

The methodology

The methodology is defined by Arksey and O'Malley (2005), the five framework stages are:

Framework stage 1: *Identifying the research question*: As with any systematic review, starting point is to identify research questions that need to be addressed.

Framework stage 2: *Identifying relevant studies*: At the beginning, we conducted a targeted search on the e-learning, m-learning, and d-learning. Then, we have used some keywords on the two search databases, namely, Google (only scientific articles were considered) and Google Scholar. And for each of the keywords we searched up to 10 pages. "E-learning, M-learning, D-learning", "Digital learning for education" (first 10 pages of Google Scholar), "Mobile learning teaching and learning", "Comparative analysis of E-learning, M-learning, and Digital learning", Digital learning environment (first 10 pages of Google and Google Scholar), "Digital learning" (first 10 pages of Google).

Framework stage 3: *Study selection*: Our initial search picked up from two search databases a large number of relevant studies. From this initial search using two databases, we have found a total of 292 articles. Having read all the 292 articles we found that a total of 280 articles were related and selected for inclusion in the review.

Framework stage 4: *Charting the data*: Having read all the 280 articles, we have summarized in a Microsoft word document a total of 130 pages of all the information. Then, we have put information from each article in a Microsoft word document. In general, this information was about the study and specific information relating to, for instance, study population, type of the intervention, outcome measures that employed, and the study design. And finally, we kept information (such as author(s), year of publication, study location, intervention type, comparator, study population, aims, methods, literature, results, etc.) that are related to our study with regard to the e-learning, m-learning, and d-learning.

Framework stage 5: *Collating, summarizing, and reporting the results*: We have gone through all the 280 articles step by step and selected a total of 126 articles and these 126 articles were

directly related with the e-learning, m-learning, and d-learning study. We analyzed these 126 articles that are directly associated to our key themes. This have presented with a graphical representation in Figure 1.

Conceptual definition

E-learning is "the learning supported by digital electronic tools and media" and m-learning is the "e-learning using mobile devices and wireless transmission" (Hoppe et al., 2003: 255) and finally, the "Digital learning is any type of learning that is facilitated by technology or by instructional practice that makes effective use of technology" and it occurs in all learning areas and domains (Victoria State Government, 2017: n.p.). While having significant impact on the sustainable development and on the living conditions (Podlacha et al., 2016), e-learning, m-learning, and d-learning seem to be very closely related. But there are some differences among them. M-learning is the subset of e-learning and d-learning is the combination of e-learning and m-learning. This is represented in Figure 2.

D-learning is a term that is increasingly replacing e-learning and it concerns the use of information and communication technology (ICT) in the open and distance learning. Furthermore, d-learning is the technical solution to support teaching, learning as well as for the studying activities (Suhonen, 2005) and it can also be an educational software, a digital learning tool, an online study program or a learning resources (Anohina, 2005). D-learning technologies enhance learners grasping more quickly and fully in order to connect theory and application adeptly. In addition, it also improves the instructional techniques, leveraging instructor time, and to facilitate the widespread of knowledge sharing. It is a new and better way to create possibilities beyond limits of our current imagination (https://odl.mit.edu/value-digital-learning).

Some of the definitions of d-learning are given below:

• "Digital learning means bringing this together in a format that fits today's digital world of work. All great learning organizations should deliver learning solutions through simulations, collaboration, meeting other people and learning from experts. So, digital
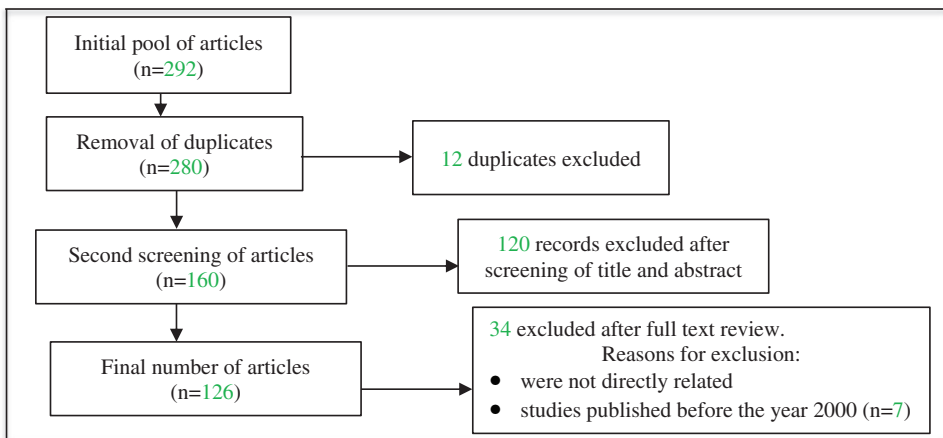

Figure 1. Flowchart of the studies included in the review.

learning is not all digital, but it should take advantage of digital tools in an integrated way" (Bersin, 2017: 1).

- "The term 'digital learning' means any instructional practice that effectively uses technology to strengthen a student's learning experience and encompasses a wide spectrum of tools and practices:

  - Interactive learning resource, digital learning content (which may include openly licensed content), software, or simulations, that engage students in academic content;
  - Access to online databases and other primary source documents;
  - The use of data and information to personalize learning and provide targeted supplementary instruction;
  - Online and computer-based assessments;
  - Learning environments that allow for rich collaboration and communication, which may include student collaboration with content experts and peers;
  - Hybrid or blended learning, which occurs under direct instructor supervision at a school or other location away from home and, at least in part, through online delivery of instruction with some element of student control over time, place, path, or pace" (Renton School District: n.p.).

According to Behera (2013), m-learning is involved in e-learning and mobile computing. M-learning is considered to be an extension of e-learning, but the quality of m-learning can be delivered with the awareness of special limitations and benefits of mobile devices. Sánchez-Prieto et al. (2016) stated that m-learning is a method of learning which is directly linked to the e-learning and it belongs to the independent typology, where teaching and learning process can have an electronic context. Kothamasu (2010) argued that m-learning is nothing but learning through the use of mobile devices and it is targeted to those who are on the move and the current mobile phones can support many latest services such as SMS, GPRS, MMS, email, packet switching, WAP, Bluetooth and many more. Besides mobile communications, there is a wide range of mobile products available such mobile scanner, mobile printers and moble labelers (Kothamasu, 2010: n. p.).
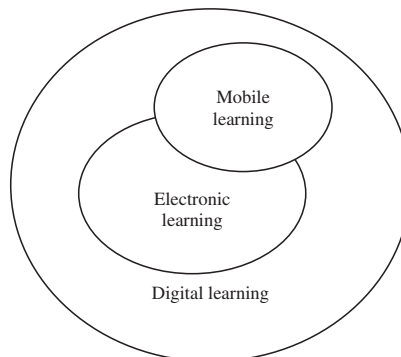

Figure 2. Relationship of e-learning, m-learning, and d-learning.

According to Kothamasu (2010), mobility helps to expand teaching and learning beyond the traditional classrooms and the m-learning can increase the flexibility as well as it opens a new opportunity within the classroom for instructors and learners.

Some of the definitions of m-learning are given below:

- "M-learning is learning as it arises in the course of *person-to-person* mobile communication" (Oloruntoba, 2006 as cited in Clark, 2007: 7).
- "Mobile learning is learning through mobile computational devices" (Quinn, 2000 as cited in Behera, 2013: 63).
- "M-learning is not just electronic, it's mobile".
- "Mobile learning as a form of education whose site of production, circulation and consumption is the network" (Polsani, 2003, as cited in Behera, 2013: 63).
- "M-learning is the use of mobile technology to aid in the learning, reference or exploration of information useful to an individual at that moment or in a specific use context" (Feser, 2010, as cited in Mboungou Mouyabi, 2012: 787).

According to Duderstadt et al. (2002), e-learning is used in the study environments to learn with a special importance of the web to describe a wide range of applications of electronic technologies, namely, TV, radio, CD-ROM, DVD, cell phone, Internet, etc. Sharma and Kitchens (2004) stated that e-learning includes learning with the help of a web-based training facilities such as virtual universities and classrooms that allows digital collaboration and technology assisted distance learning. E-learning innovation can be defined as the technological or the methodological e-learning forms that are perceived as new by the potential users (Fischer, 2013). According to Ally (2005), e-learning plays a significant role in any nations in the educational growth and it offers opportunities to develop nations in order to enhance their educational development. Furthermore, it also helps for the new generation of teachers to upgrade their skills for pedagogies of learning of the existing teaching force to the 21st century tools. Behera (2013) also stated that the modern technology, namely, the Internet is no longer limited within the four walls of classrooms and it includes all sorts of electronically supported learning as well as teaching. E-learning is defined as learning through the use of electronic devices, namely, desktop/laptop computers, smart phones, CD/DVD players, etc. that was firstly emerged in 1980s as a contender to the classical face-to-face learning (Abuhamdeh, 2010; Wains and Mahmood, 2008). The growth of e-learning is accredited to advantages such as manpower, cost, flexibility, and convenience (Ozkan and Koseler, 2009).

Some of the definitions of e-learning are given below:

- "E-learning refers to the use of computer network technology, primarily over or through the internet, to deliver information and instructions to individuals" (Wang et al., 2010: 167).
- "E-learning covers a wide set of applications and processes, including multimedia online activities such as the web, Intéernet video SD-ROM, TV and radio. Students can use these materials to teach themselves" (Hassenburg, 2009 as cited in Tittasiri, 2003: 68).
- "E-learning is a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via internet, intranet/extranet (LAN/WAN), audio and video tapes,

satellite broadcast, interactive TV, and CD-ROM" (ASTD in DeRouin et al., 2005 as cited in Norén Creutz and Wiklund, 2014: 303–304).

- "E-learning as the experience dimension of e-learning, which includes such factors as engagement, curiosity, simulation and practice" (Elliott Masie as cited in Behera, 2013: 67).

Terminology used in E-learning, M-learning, and D-learning

The transition from e-learning to m-learning to d-learning can be characterized by a change in the terminology of learning environment. Many studies have shown how to distinguish e-learning, m-learning, and d-learning by analyzing the descriptions of these three fields that are found in the existing literature.

Some of the terminology from the existing literature of e-learning, m-learning, and d-learning is given in Table 1.

Fundamental perspectives of E-learning, M-learning, and D-learning

Each of these learning tools has fundamental perspectives, namely, cognitive perspective, emotional perspective, behavioral perspective, contextual perspective. M-learning has three fundamental perspectives such as mobility of technology, mobility of learning, and mobility of learner. Finally, for the d-learning perspectives are technology, digital content, and instruction.

Figure 3 represents the graphical depiction of four fundamental perspectives of e-learning that are delivered in higher educational institutions and these four fundamental perspectives of e-learning are interdependent and equally important in terms of making electronic devices feasible as instruments for the delivery of educational institutions.

Cognitive perspective: Cognitive perspective focuses on the cognitive processes that involves in the learning and how does brain works (Clark, 2007). In order to apply the cognitive pedagogical models in an e-learning environment, the smart learning system and adaptive learning technology can be used to optimize learner's progress; virtual (simulated) worlds and other structured learning environments that can also help learners in the content. The support system can be guided and be used quickly to teach learners to communicate; and social and other collaborative tools can be used to promote dialogue, interaction, and vicarious learning (Tlambda, 2014).

Emotional perspective: Emotional perspective focuses on motivation, engagement as well as other emotional aspect of learning (Clark, 2007). Kim (2008) points out various emotions, namely, pride, frustration, relief, resistance, fear, expectation, hopelessness, anxiety, confidence, complex, and the envy confirms that these functions are strongly associated with the integration of cognition, motivation, and action.

Behavioral perspective: Behavioral perspective focuses on the skills and behavioral outcomes of the learning process (Clark, 2007; HRDI Developmentinfo, n.d.) and it focuses on the role-playing and application to on-the-job settings (Ryan, 2012).

Contextual perspective: Contextual perspective focuses on the environmental and social aspects that can stimulate learning (Clark, 2007; Ryan, 2012) and it focuses on the interaction with people, discovery of collaboration as well as the importance of peer support and pressure (Ryan, 2012).

Table 1. Terminology used in E-learning, M-learning, and D-learning.

E-learning terminology	M-learning terminology	D-learning terminology
Computer (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Mobile (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Adaptive learning (Jones and Jo, 2004; Yang et al., 2013)
Bandwidth (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004)	Bluetooth, GPRS, 3G (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Badging and gamification (Olsson et al., 2015; Gibson et al., 2015; Garrison and Kanuka, 2004)
Multimedia (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Objects (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004)	Blended learning (Bonk and Graham, 2006; Victoria State Government, 2017)
Interactive (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Traxler, 2007; Soualah-Alila et al., 2013)	Networked (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Classroom technologies (López, 2010; Robin, 2008)
Hyperlinked (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Situated learning (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013; Traxler, 2007)	E-textbooks (Dennis, 2011; Davy, 2007)
Collaborative (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Realistic situation (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004)	Learning analytics (Siemens and Baker, 2012; Slade, 2013)
Distance learning (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Constructivism (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Learning objects (Nash, 2005; Sarah et al., 2004)
Simulated situation (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Social interaction (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004)	Mobile learning (Alexander, 2004; Hwang and Chang, 2011)
Hyper learning (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Collaborative (Laouris and Eteokleous, 2005; Sharma and Kitchens, 2004; Soualah-Alila et al., 2013)	Personalized learning (Dabbagh and Kitsantas, 2012; McLoughlin and Lee, 2010)
Media-rich (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013; Traxler, 2007)	Spontaneous (Laouris and Eteokleous, 2005; Traxler, 2007; Soualah-Alila et al., 2013)	Online learning (or e-learning) (Anderson, 2008; Hiltz and Turoff, 2005)
More formal (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013)	Connected (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013)	Open educational resources (Beetham and Sharpe, 2013; Hilton et al., 2010)
Structured (Traxler, 2007)	Lightweight (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013)	Technology-enhanced teaching and learning (Hannafin and Land, 1997; Manca and

(continued)

Table 1. Continued.

E-learning terminology	M-learning terminology	D-learning terminology
		Ranieri, 2013; Manouselis et al., 2011)
Broadband (Traxler, 2007)	Informal (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013; Traxler, 2007)	Virtual reality (Bailenson et al., 2008; Merchant et al., 2014)
Intelligent (Traxler, 2007)	Situationism (Laouris and Eteokleous, 2005; Soualah-Alila et al., 2013)	Game-based learning (Erhel and Jamet, 2013; Kiili, 2005; Van Eck, 2006; Victoria State Government, 2017)
Usable (Traxler, 2007)	Personal (Traxler, 2007)	Accessing digital content (Littlejohn et al., 2012; Victoria State Government, 2017)
Lecture in classroom or in Internet labs (Soualah-Alila et al., 2013)	Disruptive (Traxler, 2007)	Collaborating locally and globally (Victoria State Government, 2017)
More text- and graphics-based instructions (Soualah-Alila et al., 2013)	Opportunistic (Traxler, 2007)	Assessment and reporting online (McDaniel et al., 2012; Palmer and Holt, 2009; Victoria State Government, 2017)
	Pervasive (Traxler, 2007)	Active participation in online communities (Lock, 2006; Victoria State Government, 2017)
	Private (Traxler, 2007)	Using technology to connect, collaborate, curate and create (Victoria State Government, 2017)
	Context-aware (Traxler, 2007)	
	Bite-sized (Traxler, 2007)	
	Portable (Traxler, 2007)	
	Learning takes place while mobile (Soualah-Alila et al., 2013)	
	More voice, graphics and animation based instruction (Soualah-Alila et al., 2013)	

Figure 4 represents the graphical depiction of three fundamental perspectives of m-learning that are delivered in higher educational institutions and these three fundamental perspectives of m-learning are interdependent and equally important in terms of making mobile devices viable as instruments for the delivery of educational institutions.

Mobility of technology: Mobile technology refers to the digital cellular phones that are used to deliver different educational content and instructors for learners (Trinder, 2005). Most of
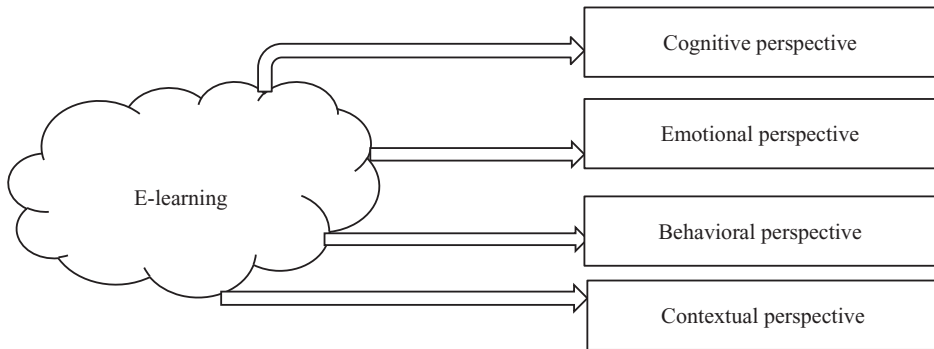
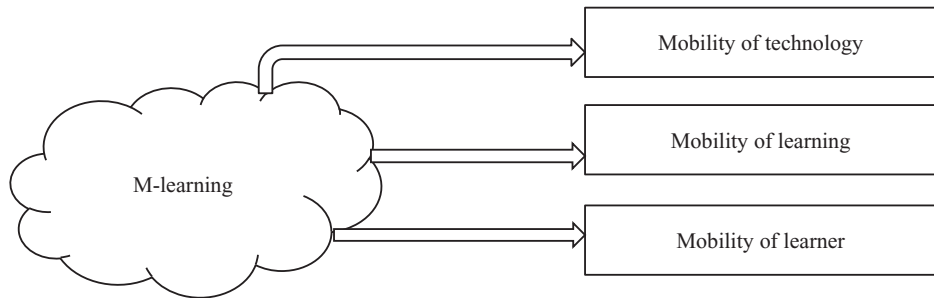**Figure 3.** Fundamental perspectives of e-learning.

Figure 4. Fundamental perspectives of e-learning adopted from El-Hussein and Cronje (2010: 17).

these cellular phones are connected to public switching telephone network and have many services, namely, email, WAP, Bluetooth, SMS, GPRS, MMS, etc. (Kothamasu, 2010).

Mobility of learners: With the m-learning, learning can be at any place and at any time. The m-learning is a platform where learners can have interaction opportunities with their fellow learners and educators from different locations although they will not be in the formal classroom (Kukulska-Hulme and Taxler, 2007). M-learning is not restricted to learners in a specific physical environment, a specific delivery channel, or for the particular set of training and education (Naismith et al., 2004). Then m-learning concerns either formal or informal education but also non-formal education.

Mobility of learning: The mobility of learning is a powerful learning experience where learners can move from everyday context and can develop themselves in terms of any professional, social, intercultural, and interpersonal competencies (Lifelong Learning Platform, n. d). M-learning is engaged in the pioneering experiments to transmit the full content of higher educational learning, especially for learners using mobile cellular devices. According to Walker (2007), learning experience with mobile devices is unique since it can receive and process within the context for which a learner is situated. And the context is utterly individual – as well as entirely different from the rigid outlay of a traditional classroom or to the lecture room, and finally in the computer laboratory.
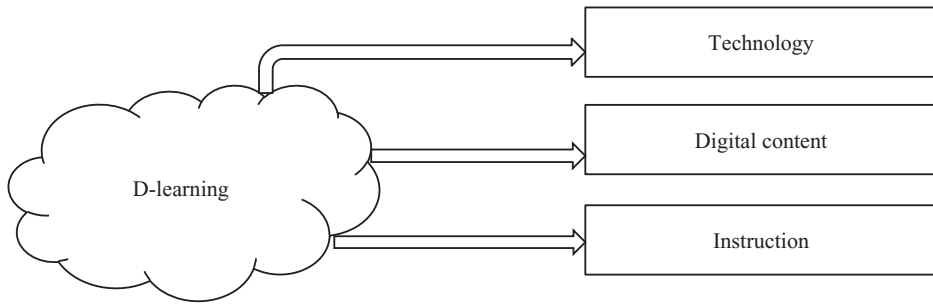
Figure 5. Fundamental perspectives of d-learning.

Figure 5 represents the graphical depiction of three fundamental perspectives of d-learning that are delivered in higher educational institutions and these three fundamental perspectives of d-learning are interdependent and equally important in terms of making digital devices viable as instruments for the delivery of educational institutions.

Digital "learning facilitated by technology that gives students some element of control over time, place, path and/or pace" (DDLN, n.d.) as cited in Georgiagov (n.d.: n.p.). *In the case of time*, learning is not restricted anymore to the school day or to the school year and the Internet access have given learners to learn anytime. *In the case of place*, the learning is not restricted to four walls of classrooms because the Internet has given the opportunity for learners to learn anywhere and everywhere (Georgiagov, n.d.). *In the case of path*, learning is not restricted to pedagogy used by teachers because the interactive and adaptive software allows learners to learn in their own style, making learning personal and engaging. In addition, learning technology provides a real time data that provide teachers relevant information which are needed to make the adjustment of instruction in order to meet the unique need of each learner (Georgiagov, n.d.). *In the case of pace*, learning is not restricted to the pace of an entire classroom of learners and software such as interactive and adaptive software allows learners to learn at their own pace and spend time more or less on lessons or subjects in terms of achieving the same level of learning (Georgiagov, n.d.).

D-learning needs a combination of technology, digital content, and the instruction and below each term is explained.

Technology: Technology is a tool, but it is not an instruction and it is a mechanism which delivers the content and it enables learners to receive the contents. Technology also incorporates Internet access and hardware that can be any Internet access device – from the desktop to the laptop to iPad to the smartphone (Georgiagov, n.d.).

Digital content: Digital content is a high quality of academic material that is delivered through technology and it is not just a PDF of the text or the PowerPoint presentation. It is ranged from the interactive and adaptive software to classic literature to video lectures to games (Georgiagov, n.d.).

Instruction: Educationists are required for digital education. Technology can change the teacher's role, but it will never end teacher's requirements. Through digital education, teachers will be able to provide personal guidance and support to learn and to stay on

track – for years and years after year – to graduate to high school. The teacher can be the guide next; the sage is not on stage (Georgiagov, n.d.).

E-learning, M-learning and D-learning over the time

E-learning

The e-learning term was originated in the mid-1990s when the Internet began to gather the momentum (Garrison, 2011) and the application of e-learning includes a computer-based learning as well as web-based learning. Finally, these learning contents can be transferred via Internet, intranet, video/audio tapes, CD-ROM, DVD, and TV channels (Mohanna, 2015). Papanis (2005) as cited in Tittasiri (2003: 69) stated that "e-learning provides faster learning at reduced cost, increased access to learning, and clear accountability for all participants in the learning process".

A study conducted by Harriman (2010) indicated different types of e-learning, namely, online learning, distance learning, blended learning, m-learning. *In the case of online learning*, it is done through the Web and it may add graphics, animation, text, audio, video, email, discussion boards, and testing. In addition, it is self-directed and "on demand" but it can incorporate the web-based teleconference such as audio, graphics, synchronous chat, or technology that are similar (Harriman, 2010). *In the case of distance learning*, it takes place when learners and instructors are not in the same place and also when learners and instructors are at the same place but not at the same time. In recent days, the distance learning takes place using the number of media and these media are from the postal mail to the teleconferencing or the Internet. In addition, these two terms such as distance learning (learner focus) and distance education (instructor focus) are used interchangeable since learning is the result of education. *In the case of blended learning*, it is nothing but the combination of two learning steps that are face-to-face learning and online learning. The main purpose of blended learning is to combine delivery modalities of the efficient and effective instruction experience. Furthermore, it is used to describe a solution that includes different delivery methods, namely, collaboration software, Web-based courses, and the electronic performance support systems. *In the case of m-learning*, it is used to handheld many information technology devices that can be used in teaching and learning namely, personal digital assistants (PDAs), mobile phones, laptops.

According to Rosenberg (2001) and Wentling et al. (2000), e-learning is the use of Internet technologies that can provide a wide range of solutions to enhance knowledge and performance. It facilitates and enhances the learning through and based on the computer and communication technology. In addition, it can also support learning using a Wide Area Network (WAN) and it can be considered as a flexible learning. Papanis (2005) stated that e-learning components include the content delivery in different formats, to manage the learning experience, learners' network community, and content developers and experts. E-learning is a personalized approach that focuses on the individual learner and it includes self-paced training, many of the virtual events, mentoring, simulation, collaboration, assessment, competency road map, authoring tools, e-store, and the learning management system. E-learning also includes many of the different components that are very familiar with the traditional learning, namely, learner's presentation ideas, group discussions, arguments and other different forms that conveying the information accumulating knowledge (Bencheva, 2010).

Researcher found that e-learning factors include bandwidth (Homan and Macpherson, 2005), lack of formal implementation process (Masoumi and Lindström, 2012), lack of interest of faculty (Forman et al., 2002; Qureshi et al., 2012), lack of ICT-enabled teachers (Carr, 1999; Iqbal and Ahmad, 2010; Levy, 2003; Nawaz and Khan, 2012; Põldoja et al., 2012), lack of ICT-enabled students (Oliver, 2001; Qureshi et al., 2012; Qureshi et al., 2011), power failure (Sangi, 2008; Iqbal and Ahmad, 2010), lack of learning objects (LO) in local language (Khattak, 2010), socio-cultural norms (Iqbal and Ahmad, 2010), lack of resources (Iqbal and Ahmad, 2010), accessibility of Internet broadband (Farid et al., 2014), cost of mobile Internet, practical arrangements for practical oriented courses, and literacy rate (Expert opinion) (Farid et al., 2015).

M-learning

It is in 1960s by Alan Kay that the concept of the mobile educational device was established (Najmi and Lee, 2009 as cited in Pollara, 2011). M-learning is portable electronic devices that are used as a trend in higher education in order to access and share information (Geist, 2011; Miller, 2012). Kothamasu (2010) argued that five basic parameters are used in m-learning, namely, portable, social interaction, sensitive to the context, connectivity, and customized. *In the case of portable*, it is easy to carry such as PDA along with users everywhere, including a restroom and this can help learners to get information very quick and rapid. *In the case of social interaction*, it helps to interact with friends to send messages. In addition, it also helps to exchange data with other people and get and gain some extra knowledge. *In the case of sensitive to the context*, it helps to gather data (real data and simulated data) unique to the current location, time, and the environment. *In the case of connectivity*, it helps to get a strong network where a learner can connect to mobile phones, data collection devices, and to a common network. Finally, *in the case of customized*, it is very unique because it can help learners to customize learning information.

A study was conducted by Sobri and Fatimah (2012) in Malaysian students' on the awareness and requirements of mobile learning services in higher education and the results of the study revealed that students have enough knowledge and awareness to incorporate m-learning in their education environment. Another study conducted by Mao (2014) at the southwest university on 300 undergraduate learners and the study revealed that 76% of the learners were satisfied to use m-learning. In addition, 84% of the respondents also indicated that they will use m-learning as a future learning. Furthermore, the study also revealed that the majority of the learners was immensely benefited from the m-learning because it helped them to solve problems very quickly that they were encountered in the learning.

Using m-learning, learning setting is changing frequently because of the mobility of learners, learning technology, and learning content. According to Chen and Kotz (2000), there are four categories of mobile context, namely, computing context, user context, physical context, and the time context. *Computing context* is all about a network connection, communication bandwidth, and the used resources. The *user context* is all about the learner profile and location. The *physical context* is all about noise, lighting, traffic conditions, the temperature of the learner's physical location. Finally, in the case of *time context*, it is all about the specific time of learning. Similarly, Zhao and Zhu (2010) and Li and Qiu (2011) stated three important factors that are needed to be considered when dealing with the m-learning systems and having considered, these three pillars can provide the desired level of quality. These three pillars are namely, learner's style, mobile, mobile device or applications,

and the learning content. Furthermore, the advanced hardware of mobile devices such as camera, accelerometer, and different software such as Apps provides more capability to manipulate, organize, and to generate the formation for teaching and learning (Chen et al., 2008; Keskin and Metcalf, 2011).

Mohanna (2015) stated that m-learning can be integrated with the help of various software and hardware technologies into the multimedia applications that can facilitate to communicate the educational format in different formats such as games, short messages, quizzes, and multimedia contents. Similarly, m-learning can also be applied to many subjects in different level of education such as primary, secondary, higher, lifelong, community, and the professional education. Different devices of m-learning applications includes usually general mobile phone, PDA, smart phone, portable media player (Apple's iPod), or event in the tablet computer and all these applications are incorporated with the WiFi, 4G, and 4G Long Term Evaluation (LTE) telecommunication networks.

Sharples (2006) as cited in Pollara (2004: 67–68) stated that m-learning

> i) enables knowledge building to take place in different contexts; ii) provides the ability to gather data unique to the current location, environment, and time (real and situated); iii) enables learners construct their own understanding (customized to the individuals path of investigation); iv) changes the pattern of learning or the work activity (supports interactivity); v) supports the use of mobile learning applications which are mediating tools and can be used in conjunction with other learning tools; and vi) goes beyond time and space in which learning becomes part of a greater whole.

According to Song (2007), using mobile devices, the course content can be divided into six categories such as pushing, messaging, response and feedback, file exchange, posting, and the classroom communication.

A study conducted by Adeyeye et al. (2013) revealed that several factors that are linked with the success or failure of m-learning projects and these factors are from the existing literature, namely, technology availability, support of the concerned institution, network connectivity, assimilation with study curriculum, student experience, or real life and the technology ownership by the learners. According to UNESCO (2011), m-learning considers several factors for the successful adoption and these factors are affordability, leadership, content, support from educators and parents, well-defined m-learning goals, recognition of informal learning, and the defined target learner groups for m-learning. Huang et al. (2010) revealed that m-learning applications not only can facilitate learners but also can interact with others for collaborations anytime and anywhere. Hereafter, m-learning for the education has significant implications in the way learners and instructors interact in educational institutions.

D-learning

D-learning is perceived to be an educational tool that is capable to change the way higher education is delivered and it continues to getting wide spread and to gaining popularity day by day in the digital world (Chitkushey et al., 2014). It is an instructional practice that is effectively used by technology in order to strengthen students' learning experience. It encompasses

a wide spectrum of tools and practices, including, among others, online and formative assessment; an increase in the focus and quality of teaching resources and time; online content and courses; applications of technology in the classroom and school building; adaptive software for students with special needs; learning platforms; participation in professional communities of practice; and access to high-level and challenging content and instruction (Alliance for Excellent Education, 2012, as cited in Council of State Governments, 2013: n.p.)" (Council of State Governments, 2013: n.p.)

D-learning can also facilitate new strategies and formats, namely, online and blending learning and the competency-based learning that has a potential in terms of contributing to the deeper learning (VanderArk and Schneider, 2012). D-learning can promote three different ways to enhance the deeper learning such as personalized skill building, schools and tools, and the extended access (VanderArk and Schneider, 2012).

According to Suhonen (2005), d-learning environments can provide solutions to support learning, teaching and studying activities. Anohina (2005) stated that d-learning environment is educational software, digital learning tool, and online study program or the learning resource. Wit and Dompseler (n.d.) urged that the d-learning environment can consist of different components where learners and teachers can use as it is needed. Furthermore, they also stated that some of the components will only be available to all learners and teachers at the institution whereas others needed authorization. These components must be swappable between learners and teachers in order to adopt the latest development in the education and to the technological innovations. These components are namely organization of learning; testing; submission and assessment of assignments; management and use of student information; timetabling; internships and final projects; developing, managing, and sharing learning materials; education process support; learning analytics; communication; collaboration; multimedia; and freely available applications.

In the case of *organizational of learning*, it makes assurance to learners that clear and easy accessibility for the right content. In addition, this also includes the functionalities namely, learners assigning into groups, learners assigning to courses and finally arranging their access management. In the case of *testing*, it can improve the learning quality and testing in the education. For the *submission and assessment of assignment*, it is a key element of the learning environment that is provided by an uploaded tool. Moreover, this component also incorporates the functionalities to manage the submission and evaluation process, namely, setting and communicating deadlines (deadline alerts and the inclusion of deadlines for learner's calendars), to allocate the first and second assessors, to coordinate between assessors, to provide feedback to learners, awarding marks for learners, notifications of assessment, and the option for learners in terms of appeal decisions. In the case of *management and use of student information*, it involves with the student administrative data management (such as personal details) and the registration of marks, progress, and the attendance (Wit and Dompseler, n.d.). For the *timetabling*, it is all about time and resource distribution across learners and teachers. In the case of *internships and final projects*, it provides the opportunity to evaluate the match between internship assignment or final assignment and the host organization and learners. For the *developing, managing, and sharing learning materials*, it deals with the functionalities in terms of developing, managing, and sharing learning materials (Wit and Dompseler, n.d.). In the case of *education process support*, it concerns with tools that are used to monitor learners' progress and giving them targeted feedback in order to support the learning process. For the *learning analytics*, it deals with the

collection and analysis of information for the learners' learning process to improve their knowledge and skills for the teaching and learning process. In the case of *communication*, it is an essential part of the sort of education that involves sending message and information and staring dialogues. For the *collaboration*, it can enable and enrich depth learning. In the case of *multimedia*, it plays an important role in the education sector and this multimedia are video, virtual reality, 3D-printing, etc. and finally, for the *freely available applications*, institutions provides learners and teachers to use social media, software and many other applications for their learning process (Wit and Dompseler, n.d.).

Some of the d-learning factors include, instructor overall rating, facilitator rating, and the overall course satisfaction (Chitkushev et al., 2014), system characteristics and their perceived functionality (Lee, 2006 as cited in Nasser et al., 2011; Hayashi et al., 2004), academic success (Heath and Ravitz, 2001), funding and technology access (Copley and Ziviani, 2004), lack of ICT knowledge and teachers provide a little support (Drent and Meelissen, 2008), teachers' attitudes and teaching styles (Selim, 2007), learner motivation (Selim, 2007), technical competency of learners (Selim, 2007), learner–learner interaction (Selim, 2007), easy access to technology (Selim, 2007), infrastructure reliability (Selim, 2007), lack of support at the postsecondary level (Selim, 2007), teachers are prone to teach using the traditional methods (Becker, 2000), novice teachers with less training are less likely to use the technology (Becker, 2000), a lack of commitment for the constructivist pedagogy (Becker, 2000), a lack of availability for the professional development (Becker, 2000), and a low level of contact between teachers who have little experience using technology (Becker, 2000).

Similarities among E-learning, M-learning, and D-learning

There are similarities among e-learning, m-learning, and d-learning; each of the tools needs infrastructure and with or without WiFi. All the three tools are digitized and used for the education environment and learners and instructors can learn on their own. The learning materials delivered in e-learning, m-learning, and d-learning are texts, images and video clips, etc. For all the three models, learners and teachers are the main users. All the three models provide learning opportunities for learners and teachers and finally for all tools, the learning materials can also be updated.

Differences between E-learning, M-learning, and D-learning

Some of the differences of e-learning, m-learning and d-learning defined by researchers are given in Table 2.

Advantages and disadvantages of E-learning, M-learning, and D-learning

Advantages and disadvantages of e-learning, m-learning, and d-learning are given in Table 3.

Conclusion

The main objective of this paper was to review and analyze the concept, terminology used, differences, fundamental perspectives, benefits, disadvantages, and the similarities and

Table 2. Differences in e-learning, m-learning, and d-learning.

E-learning	M-learning	D-learning
Communicating with email (Cisco, 2013) or E-mail to Email (Mboungou Mouyabi, 2012)	Instant messaging (Cisco, 2013; Mboungou Mouyabi, 2012)	Direct contact to the moderator (Edudip, 2016), Connect communities to a vast network of resources (OpenEdSolution, 2011)
Lecture in classroom (Cisco, 2013; Mouyabi, 2012) or internet lab (Mboungou Mouyabi, 2012), synchronous (Cisco, 2013)	Lecture capture technology, learning can be synchronous or asynchronous (Cisco, 2013)	Connect in the most remotes (OpenEdSolution, 2011), users can learn specific subject (Maniar et al., 2008), more flexible and accessible learning (Easton and Campbell-Wright, 2013; Easton and Downes, 2016)
Fixed location, plugged in (Cisco, 2013)	Collecting and analyzing data in the field (Cisco, 2013)	Own style that maximizes success (OpenEdSolution, 2011)
Tethered (Cisco, 2013)	Untethered (Cisco, 2013)	Exchange with other learners (Edudip, 2016)
More formal, paced, structured delivery (Cisco, 2013)	Less format, self-paced, on-demand (Cisco, 2013)	With digital learning can access high quality and rigorous courses (OpenEdSolution, 2011).
Private location (Mboungou Mouyabi, 2012)	No geographic Boundaries (Mouyabi, 2012)	Anywhere anytime learning creates a new world of opportunity (Conneal, 2013)
Travel time to reach the internet site (Mboungou Mouyabi, 2012)	No travel time with wireless internet connectivity (Mouyabi, 2012)	Time and location independent (Edudip, 2016)

Table 3. Advantages and disadvantages in e-learning, m-learning, and d-learning.

	Advantages	Disadvantages
E-learning	Easy access (Aczel et al., 2008; Behera, 2013), individual instructions (Behera, 2013), different learning style (Behera, 2013), flexibility (Behera, 2013), motivating and interesting (Behera, 2013), on-line, off-line, and live interaction (Behera, 2013), self-learning and the self-improvement (Behera, 2013), feedback and evaluation (Behera, 2013), efficient and cost-effective strategy (Frehywot et al., 2013)	Required knowledge and skills (Behera, 2013), lack of equipment (Behera, 2013), isolation (Behera, 2013), missing social contact (Behera, 2013), negative attitude (Behera, 2013), technical defect (Behera, 2013), stressful and consumed more time (Behera, 2013), lack of co-curricular activities (Behera, 2013), lack of teacher training program (Behera, 2013)
M-learning	Accessibility (Chen et al., 2002; Desmond, 2002; Upadhyay, 2006), interactivity	Screen size and key size (Gautam, 2014; Maniar et al., 2008), required

Table 3. Continued.

	Advantages	Disadvantages
	(Chen et al., 2002; Desmond, 2002; Upadhyay, 2006), immediacy (Chen et al., 2002), adaptability (Chen et al., 2002), placing of instructional activities (Chen et al., 2002), inexpensive (Crescente and Lee, 2011; Elias, 2011), multimedia content delivery (Crescente and Lee, 2011; Elias, 2011), decrease training cost (Crescente and Lee, 2011; Elias, 2011), communication skill (Gautam, 2014), better management (Gautam, 2014), flexibility of learning spaces (Alexander, 2004), portability Desmond, 2002; Upadhyay, 2006), motivation (Desmond, 2002; Upadhyay, 2006), open to society Desmond, 2002; Upadhyay, 2006)	bandwidth (Mehdipour and Zerehkafi, 2013), limited memory (Mehdipour & Zerehkafi, 2013), specific device file/asset format (Mehdipour & Zerehkafi, 2013), obsolescence (Mehdipour and Zerehkafi, 2013), cost (Ishtaiwa, 2016; Pegrum et al., 2013; Veerasamy, 2010), distraction (Ishtaiwa, 2016; Pegrum et al., 2013, Veerasamy, 2010), negative attitudes of parents (Ishtaiwa, 2016; Pegrum et al., 2013; Veerasamy, 2010)
D-learning	Personalized learning (Ark, 2015), expanded learning opportunities (Ark, 2015), high engagement learning (Ark, 2015), competency-based learning (Ark, 2015), assessment for learning (Ark, 2015, Easton and Campbell-Wright, 2013; Easton and Downes, 2016), collaborative learning (Ark, 2015), quality learning products (Ark, 2015), sharing economy (Ark, 2015), relevant and regularly updated content (Ark, 2015), the next-gen learning for educators (Ark, 2015), engagement (Conneal, 2013), time (Conneal, 2013; Edudip, 2016), location (Conneal, 2013; Edudip, 2016), pacing (Conneal, 2013), individualization (Conneal, 2013), content (Conneal, 2013), sharing (Conneal, 2013), data (Conneal, 2013), ownership (Conneal, 2013), repeat learning materials (Edudip, 2016), learning on many channels (Edudip, 2016), exchange with learners (Edudip, 2016), motivation (Easton and Campbell-Wright, 2013; Easton and Downes, 2016), strong digital sills (Easton and Campbell-Wright, 2013; Easton and Downes, 2016)	Internet access required (Edudip, 2016), self-discipline wanted (Edudip, 2016), infrastructure (Conneal, 2013), obsolesce (Conneal, 2013), preparation and development (Conneal, 2013), old paradigms (Conneal, 2013)

differences of e-learning, m-learning, and d-learning. A total of 292 articles were retrieved and reviewed from the Google and Google Scholar Databases and a total of 126 articles were taken into consideration which passed the quality appraisal criteria. All the three technology tools (e-learning, m-learning, and d-learning) are very important and play a crucial role in the modern education society. These tools help teachers as well as learners

to take responsibility of their personal growth. E-learning, m-learning, and d-learning require innovative approach that are interrelated. Therefore, we can conclude that learners and teachers need to acquire technological skills to success in the e-learning, m-learning, and d-learning environments.

Declaration of Conflicting Interests

Funding

References

Abuhamdeh M (2010) *A hierarchical framework to quantitatively evaluate success factors of mobile learning*. PhD Thesis, University of Banking and Financial Sciences, Amman, Jordan.

Aczel JC, Peake SR and Hardy P (2008) Designing capacity-building in e-learning expertise: Challenges and strategies. *Computers & Education* 50(2): 499–510.

Adeyeye MO, Musa AG, Botha A, et al. (2013) Problem with multi-video format m-learning applications. In J. E. Pelet (Eds.), *E-Learning 2.0 Technologies and Web Applications in Higher Education (Chapter 10),* Oman: IGI Global.

Alexander B (2004) Going nomadic: Mobile learning in higher education. *Educause Review* 39(5): 28–34.

Alliance for Excellent Education (2012) Culture shift: Teaching in a learner-centered environment powered by digital learning. Retrieved from www.all4ed.org/files/CultureShift.pdf

Ally M (2005) Using learning theories to design instruction for mobile learning devices. *Mobile Learning Anytime Everywhere* (pp. 5–8), London, UK: Learning and Skills Development Agency.

Anderson T (2008) *The Theory and Practice of Online Learning*. Athabasca University, Canada.

Anohina A (2005) Analysis of the terminology used in the field of virtual learning. *Educational Technology & Society* 8(3): 91–102.

Ark TV (2015) The shift to digital learning: 10 benefits. Retrieved from http://www.gettingsmart.com/2015/11/the-shift-to-digital-learning-10-benefits/

Arksey H and O'Malley L (2005) Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology* 8(1): 19–32.

Norén Creutz & Wiklund (2005) Learning paradigms in workplace e-learning research. *Knowledge Management & E-Learning* 6(3): 299–315.

Bailenson JN, Yee N, Blascovich J, et al. (2008) The use of immersive virtual reality in the learning sciences: Digital transformations of teachers, students, and social context. *The Journal of the Learning Sciences* 17(1): 102–141.

Becker HJ (2000) Access to classroom computers. *Communications of the ACM* 43(6): 24–25.

Beetham H and Sharpe R (2013) Rethinking pedagogy for a digital age: Designing for 21st century learning. Routledge publisher, 2nd edition (April 17 2013).

Behera SK (2013) E- and M-Learning: A comparative study. *International Journal on New Trends in Education and Their Implications* 4(3): 65–78.

Bencheva N (2010) Learning styles and e-learning face-to-face to the traditional learning. *Научни Трудове На Русенския Университет* 49(3.2): 63–67.

Bersin J (2017) How do you define digital learning? Retrieved from www.clomedia.com/2017/06/11/define-digital-learning/

Bonk CJ and Graham CR (2006) *Handbook of Blended Learning: Global Perspectives, Local Designs.* San Francisco, CA: Pfeiffer Publishing.

Carr J (1999) The role of higher education in the effective delivery of multimedia management training to small and medium-sized enterprises. *Educational Technology & Society* 2(2): 1–15.

Chen G and Kotz D (2000) *A survey of context-aware mobile computing research* (Vol. 1, No. 2.1, pp. 2–1). Technical Report TR2000-381, Department of Computer Science, Dartmouth College, USA. Retrieved from http://www.cs.dartmouth.edu/~dfk/papers/chen:survey-tr.pdf

Chen W, Tan NYL, Looi CK, et al. (2008) Handheld computers as cognitive tools: Technology-enhanced environmental learning. *Research and Practice in Technology Enhanced Learning* (3): 231–252.

Chen YS, Kao TC, Sheu JP, et al. (2002) A mobile scaffolding-aid-based bird-watching learning system. In: *IEE Cherian, E J and Williams, PE international workshop wireless and mobile technologies in education (WMTE2002)*, Taiwan, pp. 8–14, IEEE Computer Society Press.

Cherian E J and Williams P (2008) Mobile learning: The beginning of the end of classroom learning. In *Proceedings of the World Congress on Engineering and Computer Science*, IAENG publisher, San Francisco, USA.

Chitkushev L, Vodenska I and Zlateva T (2014) Digital learning impact factors: Student satisfaction and performance in online courses. *International Journal of Information and Education Technology* 4(4): 356–359.

Cisco (2013) The mobile learning phenomenon in education. Accelerating the delivery of personalized learning, pp. 1–37, Custom Computer Specialists, New York, USA.

Clark JD (2007) *Learning and Teaching in the Mobile Learning Environment of the Twenty-First Century*. Austin, Texas: Austin Community College.

Conneal (2013) Digital learning: Advantages and disadvantages!. Retrieved from https://5j2014msconneally.wordpress.com/2013/11/21/digital-learning-advantages-and-disadvantages/

Copley J and Ziviani J (2004) Barriers to the use of assistive technology for children with multiple disabilities. *Occupational Therapy International* 11(4): 229–243.

Crescente ML and Lee D (2011) Critical issues of m-learning: design models, adoption processes, and future trends. *Journal of the Chinese Institute of Industrial Engineers* 28(2): 111–123.

Dabbagh N and Kitsantas A (2012) Personal learning environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education* 15(1): 3–8.

Davy T (2007) E-textbooks: Opportunities, innovations, distractions and dilemmas. *Serials* 20(2): 98–102.

Georgiagov (n.d.) The Governor's Office of Student Achievement. Retrieved from https://gosa.georgia.gov/what-digital-learning

Dennis A (2011) E-textbooks at Indiana University: A summary of two years of research. Retrieved from http://crg.iupui.edu/Portals/133/PropertyAgent/15158/Files/367/e-TextbooksatIU.pdf

Desmond K (2002) *The Future of Learning from E learning to M learning*. Germany: FernUniversitat-Hagen.

Digital learning 2020: A policy report for Kentucky's digital future. Prepared in Partnership with OpenEdSolution. Retrieved from https://education.ky.gov/school/Documents/Digital%20Learning%202020%20-%0A%20Policy%20Report.pdf

Digital Learning (2011) Retrieved from https://en.wikipedia.org/wiki/Digital_learning (accessed 21 June 2017).

Drent M and Meelissen M (2008) Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers & Education* 51(1): 187–199.

Duderstadt JJ, Atkins DE and Van Houweling DE (2002) *Higher Education in the Digital Age: Technology Issues and Strategies for American Colleges and Universities*. Rowman & Littlefield Publishers/USA.

Easton S and Campbell-Wright K (2013) *Digital Learning for Niche Groups: A Learner's Perspective*. Learning & Work. Retrieved from http://www.learningandwork.org.uk/sites/niace_en/files/files/digital%20learning%20with%20niche%20groups.pdf

Easton S and Downes S (2016) *Digital Families*. Learning & Work. Retrieved from https://www.learningandwork.org.uk/wp-content/uploads/2017/01/4.1-Cross-UK-Partner-Meeting-Research-Analsis.pdf

Edudip (2016) The advantages and disadvantages of digital learning. Retrieved from https://blog.edudip.com/die-vor-und-nachteile-von-digitalem-lernen/?lang = en (accessed 21 June 2017).

El-Hussein MOM and Cronje JC (2010) Defining mobile learning in the higher education landscape. *Journal of Educational Technology & Society* 13(3): 12–21.

Elias T (2011) Universal instructional design principles for mobile learning. *The International Review of Research in Open and Distributed Learning* 12(2): 143–156.

Erhel S and Jamet E (2013) Digital game-based learning: Impact of instructions and feedback on motivation and learning effectiveness. *Computers & Education* 67: 156–167.

Farid S, Ahmad R, Niaz I, et al. (2014) Identifying perceived challenges of e-learning implementation. In: *First international conference on modern communication & computing technologies (MCCT'14)*, 26–28 February, Nawabshah, Pakistan.

Farid S, Ahmad R, Niaz IA, et al. (2015) Identification and prioritization of critical issues for the promotion of e-learning in Pakistan. *Computers in Human Behavior* 51: 161–171.

Feser J (2010) mLearning is not e-Learning on a mobile device. In: Udell C and Woodill G (eds.), John Wiley & Sons, USA.

Fischer H (2013) *E-Learning im Lehralltag: Analyse der Adoption von E-Learning-Innovationen in der Hochschullehre*. Springer-Verlag.

Forman D, Nyatanga L and Rich T (2002) E-learning and educational diversity. *Nurse Education Today* 22(1): 76–82.

Frehywot S, Vovides Y, Talib Z, et al. (2013) E-learning in medical education in resource constrained low-and middle-income countries. *Human Resources for Health* 11(1): 4.

Garrison DR (2011) *E-Learning in the 21st Century: A Framework for Research and Practice*. 2nd ed. New York: Routledge.

Garrison DR and Kanuka H (2004) Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education* 7(2): 95–105.

Gautam A (2014) Mobile learning: An effective way of teaching and learning English language. *International Journal on Studies in English Language and Literature (IJSELL)* 3(2): 50–52.

Geist E (2011) The game changer: Using iPads in college teacher education classes. *College Student Journal* 45(4): 758–769.

Gibson D, Ostashewski N, Flintoff K, et al. (2015) Digital badges in education. *Education and Information Technologies* 20(2): 403–410.

Bencheva, N. (2010). Learning styles and e-learning face-to-face to the traditional learning. *Научни Трудове На Русенския Университет* 49: 63–67.

Hannafin MJ and Land SM (1997) The foundations and assumptions of technology-enhanced students-centered learning environments. *Instructional Science* 25(3): 167–202.

Hassenburg A (2009) Distance education versus the traditional classroom. *Berkeley Scientific Journal* 13(1).

Hayashi A, Chen C, Ryan T, et al. (2004) The role of social presence and moderating role of computer self-efficacy in predicting the continuance usage of e-learning systems. *Journal of Information Systems Education* 15(2): 139–154.

Head to Head: eLearning vs mLearning: What's The Difference? (n.d.) Retrieved from www.opensesame.com/blog/head-head-elearning-vs-mlearning-whats-difference.

Gibbs M, Dosen A and Guerrero R (2009) Bridging the digital divide: Changing the technological landscape of innercity Catholic schools. *Urban Education* 44: 11–29.

Hilton J III, Wiley D, Stein J, et al. (2010) The four 'R's of openness and ALMS analysis: Frameworks for open educational resources. *Open Learning* 25(1): 37–44.

Hiltz SR and Turoff M (2005) Education goes digital. *Communications of the ACM* 48(10): 59–64.

Homan G and Macpherson A (2005) E-learning in the corporate university. *Journal of European Industrial Training* 29(1): 75–90.

Hoppe HU, Joiner R, Milrad M, et al. (2003) Guest editorial: Wireless and mobile technologies in education. *Journal of Computer Assisted Learning* 19(3): 255–259.

HRDI Developmentinfo (n.d.) Developing content for E-learning. Retrieved from https://hrdevelopmentinfo.com/developing-content-for-e-learning/

Huang YM, Hwang WY and Chang KE (2010) Guest editorial-innovations in designing mobile learning applications. *Educational Technology & Society* 13(3): 1–2.

Hwang G-J and Chang H-F (2011) A formative assessment-based mobile learning approach to improving the learning attitudes and achievements of students. *Computers & Education* 56(4): 1023–1031.

Iqbal MJ and Ahmad M (2010) Enhancing quality of education through e-learning: The case study of Allama Iqbal Open University. *Turkish Online Journal of Distance Education* 11(1): 84–97.

Ishtaiwa F (2016) Integrating mobile learning in an undergraduate course: An exploration of affordances and challenges for learners in UAE. In: *Human-Computer Interaction: Concepts, Methodologies, Tools, and Applications*, pp. 1333–1350. IGI Global, USA, David Parsons.

Jones V and Jo JH (2004) Ubiquitous learning environment: An adaptive teaching system using ubiquitous technology. In Atkinson R, McBeath C, Jonas-Dwyer D and Phillips R (Eds), *Beyond the comfort zone: Proceedings of te 21st ASCILITE Conference* (pp. 468–474) Perth, 5-8 December. Retrieved from http://www.ascilite.org.au/conferences/perth04/procs/jones.html

Keskin NO and Metcalf D (2011) The current perspectives, theories and practices of mobile learning. *TOJET: The Turkish Online Journal of Educational Technology* 10(2): 202–208.

Khattak D (2010) *Development of multimedia instruction objects for delivery in a localized e-learning environment*. Doctoral Dissertation, Allama Iqbal Open University, Islamabad, Pakistan.

Kiili K (2005) Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education* 8(1): 13–24.

Kim M (2008) Processes of emotional experiences in online discussions: Emotional changes through interacting with other students. *The Korean Journal of Educational Psychology* 22(4): 697–722.

Kothamasu KK (2010) *Odl Programmes Through M-learning Technology*. Retrieved from http://oasis.col.org/bitstream/handle/11599/2214/2010_KothamasuK_ODLProgrammes.pdf?sequence=1&isAllowed=y

Kukulska-Hulme A and Taxler J (2007) Designing for mobile and wireless learning. In: Beetham H and Sharpe R (eds) *Rethinking Pedagogy for a Digital Age: Designing and Delivering e-Learning*. London: Routledge, pp. 180–192.

Laouris YN and Eteokleous N (2005) We need an educationally relevant definition of mobile learning. In: *Proceedings of MLearn*, Cape Town, South Africa, pp. 290–294. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.106.9650&rep=rep1&type=pdf

Nasser R, Cherif M and Romanowski M (2011) Factors that impact student usage of the learning management system in Qatari schools. *The International Review of Research in Open and Distributed Learning* 12(6): 39–62.

Levy S (2003) Six factors to consider when planning online distance learning programs in higher education. *Online Journal of Distance Learning Administration* 6(1): 1–19.

Li H and Qiu F (2011) Analyzing theory characteristic and studying application mode about mobile learning. In: *International conference on electrical and control engineering (ICECE)*, pp. 6327–6330. IEEE, Yichang, China.

Lifelong Learning Platform: European Civil, Society for Education (n.d.). Retrieved from http://lllplatform.eu/policy-areas/skills-and-qualifications/learning-mobility-for-all/

Littlejohn A, Beetham H and McGill L (2012) Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning* 28(6): 547–556.

Lock JV (2006) A new image: Online communities to facilitate teacher professional development. *Journal of Technology and Teacher Education* 14(4): 663.

López OS (2010) The digital learning classroom: Improving English language learners' academic success. *Computers & Education* 54(4): 901–615.

Manca S and Ranieri M (2013) Is it a tool suitable for learning? A critical review of the literature on Facebook as a technology-enhance learning environment. *Journal of Computer Assisted Learning* 29(6): 487–504.

Maniar N, Bennett E, Hand S, et al. (2008) The effect of mobile phone screen size on video based learning. *Journal of Software* 3(4): 51–61.

Manouselis N, Drachsler H, Vuorikari R, et al. (2011) Recommender systems in technology enhanced learning. In: Rokach L, Shapira B, Kantor P, Ricci F, (eds) *Recommender Systems Handbook: A Complete Guide for Research Scientists & Practitioners*, pp. 387–409. Springer, New York, USA.

Mao C (2014) Research on undergraduate students' usage satisfaction of mobile learning. *Creative Education* 5(8): 614–618.

Masoumi D and Lindström B (2012) Quality in e-learning: A framework for promoting and assuring quality in virtual institutions. *Journal of Computer Assisted Learning* 28(1): 27–41.

Mboungou Mouyabi JSM (2012) E-learning and m-learning: Africa's search for a suitable concept in the era of cloud computing? *Word Academy of Science, Engineering and Technology* 6(5): 784–790.

McDaniel R, Lindgren R and Friskics J (2012) Using badges for shaping interactions in online learning environments. In: *2012 IEEE international professional communication conference (IPCC)*, pp. 1–4, IEEE, Orlando, Florida, USA.

McLoughlin C and Lee MJW (2010) Personalised and self-regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology* 26(1): 1449–5554.

Mehdipour Y and Zerehkafi H (2013) Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research* 3(6): 93–101.

Merchant ET, Cifuentes L, Keeney-Kennicutt W, et al. (2014) Effectiveness of virtual reality-based instruction on students' learning outcome in K-12 and higher education: A meta-analysis. *Computer & Education* 70: 29–40.

Miller W (2012) iTeaching and learning: Collegiate instruction incorporating mobile tablets. *Library Technology Reports* 48(8): 54–59. Retrieved from https://scholarworks.iupui.edu/handle/1805/3280

Mohanna M (2015) *Using knowledge engineering for modeling mobile learning systems*. Doctoral Dissertation, Université Laval, Canada.

Mouyabi JSM (2012) E-learning and m-learning: Africa's search for a suitable concept in the era of cloud computing? *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering* 6(5): 784–790.

Naismith L, Lonsdale P, Vavoula G, et al. (2004) *Literature Review in Mobile Learning*. Bristol, UK: NESTA (National Endowment for Science Technology and the Arts).

Najmi A and Lee J (2009) as cited in Pollara PC (2011) *Mobile learning in higher education: A glimpse and a comparison of student and faculty readiness, attitudes and perceptions*. PhD Thesis, Louisiana State University.

Nash S (2005) Learning objects, learning object repositories, and learning theory: Preliminary best practices for online courses. *Interdisciplinary Journal of e-Skills and Lifelong Learning* 1(1): 217–228.

Nawaz A and Khan MZ (2012) Issues of technical support for e-learning systems in Higher Education Institutions. *International Journal of Modern Education and Computer Science* 4(2): 38–44.

Norén CI and Wiklund M (2014) Learning paradigms in workplace e-learning research. *Knowledge Management & E-Learning* 6(3): 299–315.

Office of Digital Learning. Retrieved from https://odl.mit.edu/value-digital-learning (accessed 22 June 2017).

Oliver R (2001) Assuring the quality of online learning in Australian higher education. In: *Proceedings of moving online II conference*, pp. 222–231. Lismore: Southern Cross University.

Oloruntoba R (2006) *Mobile Learning Environments: A Conceptual Overview*. In Brown, A (Ed.) *Learning on the Move: Proceedings of the Online Learning and Teaching Conference 2006*, 26 September 2006, Australia, Queensland, Brisbane.

Olsson M, Peter M and Jonas C (2015) Visualisation and gamification of e-learning and programming education. *Electronic Journal of E-Learning* 13(6): 441–454.

OpenEdSolution (2011) *Digital Learning 2020: A Policy Report for Kentucky's Digital Future*.

Ozkan S and Koseler R (2009) Multi-dimensional students' evaluation of e-learning systems in the higher education context: An empirical investigation. *Computers & Education* 53(4): 1285–1296.

Palmer SR and Holt DM (2009) Examining student satisfaction with wholly online learning. *Journal of Computer Assisted Learning* 25(2): 101–113.

Papanis E (2005) Traditional Teaching versus e-learning. *Experimental Approach, Statistical Review* 1 (1): 19–35

Pegrum M, Howitt C and Striepe M (2013) Learning to take the tablet: How pre-service teachers use iPads to facilitate their learning. *Australasian Journal of Educational Technology* 29(4): 464–479.

Podlacha G, Alscher C, Amaya S, et al. (2016) Digital adult education – A key to global development? Retrieved from www.dvv-international.de/fileadmin/files/Inhalte_Bilder_und_Dokumente/ Materilien/IPE/IPE_73_web.pdf

Põldoja H, Väljataga T, Laanpere M, et al. (2012) Web-based self-and peer-assessment of teachers' digital competencies. *World Wide Web* 17(2): 255–269.

Pollara P (2011) *Mobile learning in higher education: A glimpse and a comparison of student and faculty readiness, attitudes and perceptions*. PhD Thesis, Duquesne University, USA.

Polsani P (2003) Network learning. In: Nyinri K (ed.) *Mobile Learning Essay on Philosophy, Psychology and Education*. Vienna: Passage Verlag, 139–150.

Quinn C (2000) MLearning mobile, wireless, in your pocket learning. *LiNE Zine*. Retrieved from http://www.linezine.com/2.1/features/cqmmwiyp.htm

Qureshi IA, Ilyas K, Yasmin R, et al. (2012) Challenges of implementing e-learning in a Pakistani university. *Knowledge Management & E-Learning: An International Journal (KM&EL)* 4(3): 310–324.

Qureshi QA, Nawaz A and Khan N (2011) Prediction of the problems, user-satisfaction and prospects of e-learning in HEIs of KPK, Pakistan. *International Journal of Science and Technology Education Research* 2(2): 13–21.

Renton School District (n.d.) What is digital learning? Retrieved from www.rentonschools.us/ Page/2584.

Robin BR (2008) Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into Practice* 47(3): 220–228.

Rosenberg MJ (2001) *E-Learning Strategies for Delivering Knowledge in the Digital Age*. New York: McGraw-Hill.

Ryan D (2012) E-learning modules: DLR Associates Series. Available at: https://books.google.ca/ books?id = bYxMVVzdV80C&pg = PA11&lpg = PA11&dq = Contextual+perspective+e-lear ning&source = bl&ots = jHSR1RwM0T&sig = kfm-k8Jnd1Jb6Yx7mpzyaY8bAsk&hl = en&sa = X&ved = 0ahUKEwjLo-z_itfUAhXLVz4KHVn1DO0Q6AEISzAG#v = onepage&q = Contextual %20perspective%20e-learning&f = false

Sánchez-Prieto JC, Olmos-Miguelánez S and García-Peñalvo FJ (2016) Informal tools in formal contexts: Development of a model to assess the acceptance of mobile technologies among teachers. *Computers in Human Behavior* 55(Part A): 519–528.

Sangi NA (2008) Electronic assessment issues and practices in Pakistan: A case study. *Learning, Media and Technology* 33(3): 191–206.

Sarah C, Jane B, Rónán O, et al. (2004) Quality assurance for digital learning object repositories: Issues for the metadata creation process. *ALT* 12(1): 5–20.

Selim HM (2007) Critical success factors for e-learning acceptance: Confirmatory factor models. *Computers & Education* 49(2): 396–413.

Sharma SK and Kitchens FL (2004) Web services architecture for m-learning. *International Journal of Mobile Communications* 2(1): 203–216.

Siemens G and Baker R (2012) Learning analytics and educational data mining: towards communication and collaboration. In: *Proceedings of the 2nd international conference on learning analytics and knowledge,* pp. 252–254, ACM, New York, USA.

Slade S (2013) Learning analytics: Ethical issues and dilemmas. *American Behavioral Scientist* 57(10): 1510–1529.

Sobri HA and Fatimah WW (2012) The development of new conceptual model for mobile school. In: *Proceedings of the international conference on intelligent system and informatics (ISI 2012)* (Vol. 42), 14–16 November, Valetta, Malta.

Song Y (2007) Educational uses of handheld devices: What are the uses? *TechTrends: Linking Research and Practice to Improve Learning* 51(5): 38–45.

Soualah-Alila F, Nicolle C and Mendes F (2013) Towards a methodology for semantic and context-aware mobile learning. In: *The Encyclopedia of Information Science and Technology*. 3rd ed. IGI Global, 10p. Retrieved from https://hal.archives-ouvertes.fr/hal-00876023/document

Suhonen J (2005) *A formative development method for digital learning environments in sparse learning communities*. PhD Thesis, University of Joensuu, Joensuu, Finland.

Tittasiri W (2003) A comparison of e-learning and traditional learning: Experimental approach. *International Journal of Information Technology & Computer Science* 12(3): 67–74.

Tlambda S (2014) E-learning pedagogy part 2: The cognitive perspective. Retrieved from http://blog.lambdasolutions.net/e-learning-pedagogy-part-2-the-cognitive-perspective

Traxler J (2007) Defining, discussing and evaluating mobile learning: The moving finger writes and having writ. *The International Review of Research in Open and Distributed Learning* 8(2): 1–12.

Trinder J (2005) Mobile technologies and systems. *Mobile learning: A handbook for educators and trainers*. In: Kuklska-Hulme A (ed.) *Mobile Learning: A Handbook for Educators and Trainers*. USA: Taylor & Francis, pp. 7–24.

UNESCO (2011) UNESCO mobile learning week report. Retrieved from www.unesco.org/fileadmin/MULTIMEDIA/HQ/ED/ICT/pdf/UNESCO%20MLW%20report%20final%2019jan.pdf

Upadhyay N (2006) M-Learning – A new paradigm in education. *International Journal of Instructional Technology and Distance Learning* 3(2): 27–34.

VanderArk T and Schneider C (2012) How digital learning contributes to deeper learning. Retrieved from www.faithformationlearningexchange.net/uploads/5/2/4/6/5246709/__digital_learning__deeper_learning.pdf

Van Eck R (2006) Digital game-based learning: It's not just the digital natives who are restless. *EDUCAUSE Review* 41(2): 16.

Veerasamy BD (2010) The overall aspects of e-learning issues, developments, opportunities and challenges. *Proceedings of World Academy of Science: Engineering & Technology* 4(3): 364–367.

Victoria State Government (2017). Retrieved from www.education.vic.gov.au/school/teachers/support/Pages/elearningcurriculum.aspx

Wains SI and Mahmood W (2008) Integrating m-learning with e-learning. In: *Proceedings of the 9th ACM SIGITE conference on Information technology education*, pp. 31–38. Cincinnati, OH, USA: ACM.

Walker K (2007) Introduction: Mapping the landscape of mobile learning. In: Sharples M (ed.) *Big Issue in Mobile Learning: A Report of a New Workshop by the Kaleidoscope Network of Excellence Mobile Learning Initiative*. UK: University of Nottingham, pp. 5–6.

Wang M, Ran W, Liao J, et al. (2010) A performance-oriented approach to e-learning in the workplace. *Journal of Educational Technology & Society* 13(4): 167–179.

Wentling TL, Waight C, Gallaher J, et al. (2000) E-learning: A review of literature. In: *Knowledge and Learning Systems Group*. USA: University of Illions at Urbana-Champaign, pp. 1–73.

Wit MD and Dompseler HV (n.d.) How to create a digital learning environment consisting of various components and acting as a whole? Retrived from http://www.eunis.org/download/2017/EUNIS_2017_paper_16.pdf

Yang T-C, Hwang G-J and Yang SJ-H (2013) Development of an adaptive learning system with multiple perspectives based on students' learning styles and cognitive styles. *Journal of Educational Technology & Society* 16(4): 185.

Zhao Y and Zhu Q (2010) Influence factors of technology acceptance model in mobile learning. In: *4th International conference on genetic and evolutionary computing (ICGEC)*, IEEE Shenzhen, China, pp. 542–545.

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