Online Education as the Future:

Finding New ways to Teach and Learn in the New Age

Emelyn Cereno Wagan

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LIST OF ABBREVIATIONS

AECT	Association for Educational Communications and Technology
AI	artificial intelligence
AICC	Aviation Industry Computer-Based Training Committee
AIM	articulated instructional media
AR	augmented reality
BBC	British broadcasting corporation
CAI	computer-aided instruction
CBL	computer-based learning
CBT	computer-based training
CCC	computer curriculum corporation
CHEA	Council for Higher Education Accreditation
CMC	computer-mediated communication
CMS	content management system
CSCL	computer-supported collaborative learning
DBS	direct-broadcast satellite
DEAC	Distance Education Accrediting Commission
ERP	enterprise resource planning
GES	Galileo educational system
HETA	higher education transfer alliance
HETAC	Higher Education and Training Awards Council
IAI	interactive audio instruction
IBT	internet-based training
ICDE	International Council for Open and Distance Education
ICMAPRANE	International Conference on Management Practices for the New Economy
ICT	information and communication technology

IMSSS	Institute for Mathematical Studies in the Social Sciences
IRI	interactive radio instruction
ITSs	intelligent tutoring systems
LCMS	learning content management system
LMS	learning management system
LRS	learning record store
MALL	mobile-assisted language learning
MIS	management information system
MOOC	massive open online courses
MOOD	massive online open degree
MUVEs	multi-user virtual environments
NHSC	National Home Study Council
OER	open educational resources
OLPC	one laptop per child
OU	open university
PCAST	President's Council of Advisors on Science and Technology
ROI	return on investment
SCORM	sharable content object reference model
TEL	technology-enhanced learning
VGU	virtual global university
VLE	virtual learning environment
VR	virtual reality
WBT	web-based training

PREFACE

What many of its critics deliberately or inadvertently ignored, was the fact that online education tended to attract those that were genuinely interested in learning. Because it requires a lot of effort, discipline, and sacrifice; it is hardly like that any disruptive student or lazy one for that matter will be very keen on online education. If you do not want to hand in your assignments, online education will make everything worse because there will be no tutor or mentor to see that you are not paying attention. There were some that started off with online education because they did not have the access to in-person classes that they would ideally prefer. Later on, when things looked up; these learners would try to "clean" their qualifications by attending an in-person institution.

All that was the norm until the advent of the COVID-19 crisis, a pandemic that hit the globe in 2020 and has infected both rich and poor equally. Suddenly, there were lockdowns and the traditional great institutions were looking for ways to retain their student numbers. Online education provided a solution since it was uniquely suited to an apparently captive audience that had been locked up in their homes and unable to attend traditional school. It became fashionable to offer online course as an alternative for those that were not able to come to class. Some started even questioning the need for international students to obtain visas to attend university since they could very well do it at home. Others were disquieted by the seeming mark-up bonanza that colleges were enjoying since online courses were infinitely cheaper to administer, yet the fees had not been proportionally reduced. There were also students that complained of loneliness and isolation.

This book comes at an opportune time because it addresses an education modality that has seen its fortunes transformed since the beginning of 2020. This decade is showing every sign of being dominated by online technologies. The education sector is not likely to be any different from other sectors that have had to make adjustments. The book therefore explores some of the broad themes that underpin this niche, including the opportunities for new pedagogies, curriculum reviews, health, and safety considerations, other practicalities, and the philosophical re-orientation of those that are in charge of the education sector. The book is relevant to anyone that has an interest in the education sector. It may also have relevance for those whose businesses and occupations rely on the internet. I hope you enjoy reading the book.

Chapter

1 Introduction to Distance Learning

CONTENTS

To begin this book, we will consider the notion of distance learning and its implications for modern pedagogy. Some of the key themes will include the definition of distance learning, its main histories and some examples of its practices. We will explore what the age of open universities means in terms of instructional technologies. The chapter will provide examples of how distance learning has been achieved through the strategic use of a host of tools such as radio, television, and the internet. Towards the end of the chapter, we will consider how pacing models are constructed and conceived in distance learning. The chapter will close with a critique of long-distance learning, both in terms of its how failings and also its comparative merits or demerits when compared to other modalities for delivering an education. By the end of this chapter, readers should have a basic idea of how long-distance learning is conceived and implemented.

1.1. DEFINITION, HISTORY, AND EXAMPLES OF DISTANCE LEARNING

Distance education, also called distance learning, is the education of students who may not always be physically present at a school (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Traditionally, this usually involved correspondence courses wherein the student corresponded with the school via post (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Today, it involves online education. A distance learning program can be completely distance learning, or a combination of distance learning and traditional classroom instruction (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). This is where the modality is called hybrid or blended, a preferred option when considering some of the merits of different forms of education (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Massive open online courses (MOOCs), offering large-scale interactive participation and open access through the World Wide Web or other network technologies, are recent educational modes in distance education (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010).

A number of other terms have emerged in the distance learning industry including distributed learning, e-learning, m-learning, online learning, and

the virtual classroom (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). These terms are used roughly synonymously with distance education (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Often the attitudes and adaptation of distance education followed a utilitarian approach (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Quite simply, these institutions were opened because they were urgently needed to meet the needs of industry and the learners themselves (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Figure 1.1 highlights some of the benefits of distance learning which are still referenced as the rationale for this modality of education even in contemporary times (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016).

Figure 1.1: Benefits of distance learning.

Source: Oxbridge Academy.

One of the earliest attempts at distance learning was advertised in 1728 (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). This was in the Boston Gazette for "Caleb Philipps, Teacher of the new method of Short Hand," who sought students who wanted to learn through weekly mailed lessons (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The first distance education course in the modern sense was provided by Sir Isaac Pitman in the 1840s, who taught a system of shorthand by mailing texts transcribed into shorthand on postcards and receiving transcriptions from his students in return for correction (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The element of student feedback was a crucial innovation in Pitman's system as it is in modern times (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). This scheme was made possible by the introduction of uniform postage rates across England in 1840 in much the same way as the internet has supported a global open distance education (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). This early beginning proved extremely successful, and the Phonographic Correspondence Society was founded 3 years later to establish these courses on a more formal basis (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The society paved the way for the later formation of Sir Isaac Pitman Colleges across the country (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

The first correspondence school in the United States was the Society to Encourage Studies at Home, which was founded in 1873 (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Founded in 1894, Wolsey Hall, Oxford, was the first distance learning college in the UK (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). The University of London was the first university to offer distance learning degrees, establishing its External Program in 1858 (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The background to this innovation lay in the fact that the institution (later known as University College London) was non-denominational

(Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Given the intense religious rivalries at the time, there was an outcry against the "godless" university (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). It is interesting to point out the opposite parallels in terms of modern religious schools that are seeking space in an overwhelmingly secular education system (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The issue soon boiled down to which institutions had degree-granting powers and which institutions did not (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The compromise solution that emerged in 1836 was that the sole authority to conduct the examinations leading to degrees would be given to a new officially recognized entity called the "University of London" (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This would act as examining body for the University of London colleges, originally University College London and King's College London, and award their students University of London degrees (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). This heralded the English tradition of separating teaching from examining (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015).

With the state giving examining powers to a separate entity, the groundwork was laid for the creation of a program within the new university which would both administer examinations and award qualifications to students taking instruction at another institution or pursuing a course of self-directed study (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Referred to as "People's University" by Charles Dickens because it provided access to higher education to students from less affluent backgrounds, the External Program was chartered by Queen Victoria in 1858 (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In effect, this was the University of London the first university to offer distance learning degrees to students (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Enrollment increased steadily during the late 19th century, and its example was widely copied

elsewhere (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). This program is now known as the University of London International Program and includes Postgraduate, Undergraduate, and Diploma degrees created by colleges such as the London School of Economics, Royal Holloway, and Goldsmiths (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

William Rainey Harper encouraged the development of external university courses at the new University of Chicago in the 1890s (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). In the United States, William Rainey Harper, founder, and first president of the University of Chicago, celebrated the concept of extended education, where a research university had satellite colleges elsewhere in the region (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). In 1892, Harper encouraged correspondence courses to further promote education, an idea that was put into practice by Chicago, Wisconsin, Columbia, and several dozen other universities by the 1920s (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Enrollment in the largest private for-profit school based in Scranton, Pennsylvania, the International Correspondence Schools grew explosively in the 1890s (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Founded in 1888 to provide training for immigrant coal miners aiming to become state mine inspectors or foremen, it enrolled 2500 new students in 1894 and matriculated 72,000 new students in 1895 (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). By 1906 total enrollments reached 900,000 (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The growth was due to sending out complete textbooks instead of single lessons, and the use of 1200 aggressive in-person salesmen (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001).

Education was a high priority in the Progressive Era, as American high schools and colleges expanded greatly (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). For men who were older or were too busy with family

responsibilities, night schools were opened, such as the YMCA school in Boston that became Northeastern University (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Outside the big cities, private correspondence schools offered a flexible, narrowly focused solution (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Large corporations systematized their training programs for new employees (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). The National Association of Corporation Schools grew from 37 in 1913 to 146 in 1920 (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Starting in the 1880s, private schools opened across the country which offered specialized technical training to anyone who enrolled, not just the employees of one company (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Starting in Milwaukee in 1907, public schools began opening free vocational programs (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004).

Only a third of the American population lived in cities of 100,000 or more by 1920 (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Therefore, in order to reach the rest; correspondence techniques had to be adopted as a matter of course (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Australia, with its vast distances, was especially active and continues to be a beacon for distance education even today (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). For example, the University of Queensland established its Department of Correspondence Studies in 1911 (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In South Africa, the University of South Africa, formerly an examining and certification body, started to present distance education tuition in 1946 (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The International Conference for Correspondence Education held its first meeting in 1938 (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek

and Woessmann, 2010). The goal was to provide individualized education for students, at low cost, by using a pedagogy of testing, recording, classification, and differentiation (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). The organization has since been renamed as the International Council for Open and Distance Education (ICDE), with headquarters in Oslo, Norway (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Throughout its history, distance education has provided opportunities for those that had in one way or another been excluded from mainstream education (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Hence, distance education can correctly be considered to be a supportive element when democratizing the education sector (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In the next section, we explore the age of open universities.

1.2. THE AGE OF OPEN UNIVERSITIES AND ASSOCIATED TECHNOLOGIES

The Open University (OU) in the United Kingdom was founded by the-then Labor government led by Prime Minister, Harold Wilson, based on the vision of Michael Young (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Planning commenced in 1965 under the Minister of State for Education, Jennie Lee, who established a model for the OU as one of widening access to the highest standards of scholarship in higher education (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). He also set up a planning committee consisting of university vice-chancellors, educationalists, and television broadcasters, chaired by Sir Peter Venables (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The British Broadcasting Corporation (BBC) Assistant Director of Engineering at the time, James Redmond, had obtained most of his qualifications at night school, and his natural enthusiasm for the project did much to overcome the technical difficulties of using television to broadcast teaching programs (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Figure 1.2 summarizes the values and modalities of open learning which

have often been at the heart of the OU and its sister institutions (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004).

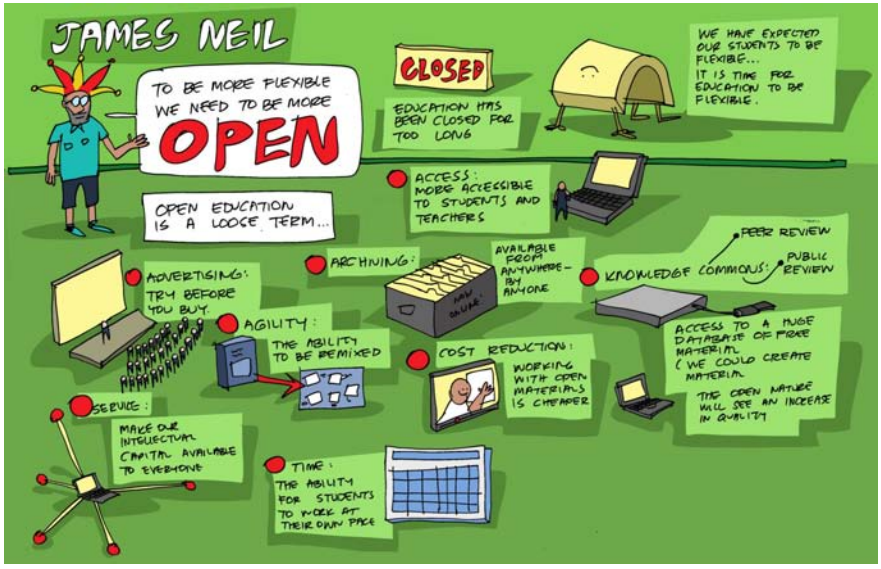

Figure 1.2: Open education and flexible learning.

Source: Wikipedia.

The OU revolutionized the scope of the correspondence program and helped to create a respectable learning alternative to the traditional form of education (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). It has been at the forefront of developing new technologies to improve the distance learning service as well as undertaking research in other disciplines (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Walter Perry was appointed the OU's first vice-chancellor in January 1969, and its foundation secretary was Anastasios Christodoulou (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). The election of the new Conservative government under the leadership of Edward Heath in 1970 led to budget cuts under Chancellor of the Exchequer Iain Macleod (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). However, the OU accepted its first 25,000 students in 1971, adopting a radical open admissions

policy (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). At the time, the total student population of conventional universities in the United Kingdom was around 130,000 (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

Athabasca University, Canada's OU, was created in 1970 and followed a similar, though independently developed, pattern (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The OU inspired the creation of Spain's National University of Distance Education (1972) and Germany's FernUniversität in Hagen by 1974 (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). There are now many similar institutions around the world, often with the name "OU" in English or in the local language (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Most open universities use distance education technologies as delivery methods (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). However, some require attendance at local study centers or at regional "summer schools. Some open universities have grown to become mega-universities (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). This is a term coined to denote institutions with more than 100,000 students (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004).

The COVID-19 pandemic resulted in the closure of the vast majority of schools worldwide (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Many schools moved to online remote learning via platforms including Zoom, Google Classroom, Microsoft Teams, D2L, and Edgenuity (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Concerns arose over the impact of this transition on students without access to an internet-enabled device or a stable internet connection (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Internet technology has enabled many forms of distance learning through open educational resources (OER) and facilities such as e-learning and MOOCs (Gil and Wakefield, 2015;

Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Although the expansion of the Internet blurs the boundaries, distance education technologies are divided into two modes of delivery: synchronous learning and asynchronous learning (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

In synchronous learning, all participants are "present" at the same time in a virtual classroom, as in traditional classroom teaching (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). It requires a timetable and similar tools to keep control of sessions as well as attendance (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Web conferencing, videoconferencing, educational television, instructional television are examples of synchronous technology (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Other examples include direct-broadcast satellite (DBS), internet radio, live streaming, telephone, and web-based VoIP (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Web conferencing software helps to facilitate class meetings, and usually contains additional interaction tools such as text chat, polls, hand raising, and emoticons for instance (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). These tools also support asynchronous participation by students who can listen to recordings of synchronous sessions (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Immersive environments (such as SecondLife) have also been used to enhance participant presence in distance education courses (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Another form of synchronous learning using the classroom is the use of robot proxies including those that allow sick students to attend classes (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

Some universities have been starting to use robot proxies to enable more engaging synchronous hybrid classes (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). This occurs where both remote and in-person students can be present

and interact using telerobotics devices such as the Kubi Telepresence robot stand that looks around and the Double Robot that roams around (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). With these telepresence robots, the remote students have a seat at the table or desk instead of being on a screen on the wall (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). In asynchronous learning, participants access course materials flexibly on their own schedules. Students are not required to be together at the same time (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Mail correspondence, which is the oldest form of distance education, is an asynchronous delivery technology, such as message board forums, e-mail, video, and audio recordings, print materials, voicemail, and fax (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001).

The two methods can be combined in order to find a modality that gets the best of both worlds whilst mitigating the disadvantageous of each method (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Many courses offered by both open universities and an increasing number of campus-based institutions use periodic sessions of residential or day teaching to supplement the sessions delivered at a distance (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). This type of mixed distance and campus-based education has recently come to be called "blended learning" or less often "hybrid learning" (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Many open universities use a blend of technologies and a blend of learning modalities (face-to-face, distance, and hybrid) all under the rubric of "distance learning" (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Distance learning can also use interactive radio instruction (IRI), interactive audio instruction (IAI), online virtual worlds, digital games, webinars, and webcasts, all of which are referred to as e-Learning (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The next section considers the use of devices such as radio, television, and the internet in modern distance learning.

1.3. USE OF TELEVISION, RADIO, AND THE INTERNET IN DISTANCE EDUCATION

The rapid spread of film in the 1920s and radio in the 1930s led to proposals to use it for distance education (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). By 1938, at least 200 city school systems, 25 state boards of education, and many colleges and universities broadcast educational programs for the public schools (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). One line of thought was to use radio as a master teacher (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Experts in given fields broadcast lessons for pupils within the many schoolrooms of the public school system, asking questions, suggesting readings, making assignments, and conducting tests (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). This mechanizes education and leaves the local teacher only the tasks of preparing for the broadcast and keeping order in the classroom (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Figure 1.3 indicates some of the training gaps for distance education in sub-Saharan Africa.

A typical setup came in Kentucky in 1948 when John Wilkinson Taylor, president of the University of Louisville, teamed up with NBC to use radio as a medium for distance education, the chairman of the Federal Communications Commission endorsed the project and predicted that the "college-by-radio" would put American education a quarter of a century ahead or other countries (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). The University was owned by the city, and local residents would pay the low tuition rates, receive their study materials in the mail, and listen by radio to live classroom discussions that were held on campus (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Physicist Daniel Q. Posin also pioneered in the field of distance education when he hosted a televised course through DePaul University (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006).

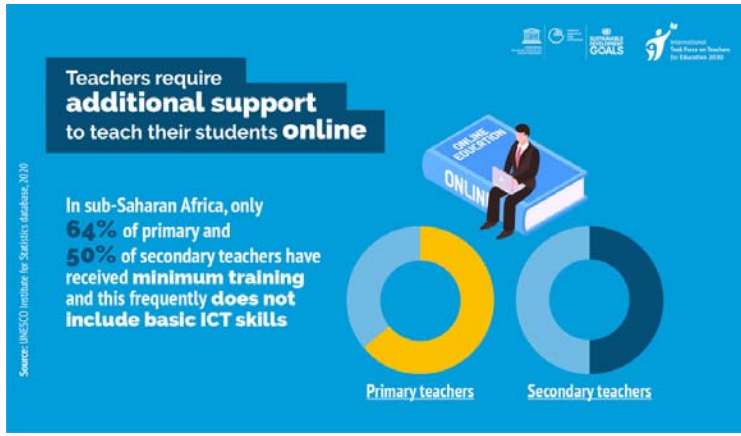

Figure 1.3: *Training gaps for online learning.*

Source: UNESCO Institute for Statistics.

Charles Wedemeyer of the University of Wisconsin-Madison also promoted new methods (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). From 1964 to 1968, the Carnegie Foundation funded Wedemeyer's articulated instructional media project (AIM) which brought in a variety of communications technologies aimed at providing learning to an off-campus population (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The radio courses faded away in the 1950s (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Many efforts to use television along the same lines proved unsuccessful, despite heavy funding by the Ford Foundation (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

From 1970 to 1972 the Coordinating Commission for Higher Education in California funded Project Outreach to study the potential of telecourses (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The study included the University of California, California State University, and the community colleges (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). This study led to coordinated instructional systems legislation allowing the use of public funds for non-classroom instruction and paved the way for the emergence

of telecourses as the precursor to the online courses and programs of today (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The Coastline Community Colleges, The Dallas County Community College District, and Miami Dade Community College led the way (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). The Adult Learning Service of the US Public Broadcasting Service came into being and the "wrapped" series, and individually produced telecourse for credit became a significant part of the history of distance education and online learning (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

The widespread use of computers and the internet have made distance learning easier and faster, and today virtual schools and virtual universities deliver full curricula online (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The capacity of the Internet to support voice, video, text, and immersion teaching methods made earlier distinct forms of telephone, videoconferencing, radio, television, and text-based education somewhat redundant (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). However, many of the techniques developed and lessons learned with earlier media are used in Internet delivery (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). The first completely online course for credit was offered by the University of Toronto in 1984 through the Graduate School of Education (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The topic was "Women and Computers in Education," dealing with gender issues and educational computing (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The first new and fully online university was founded in 1994 as the OU of Catalonia, headquartered in Barcelona, Spain (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). In 1999 Jones International University was launched as the first fully online university accredited by a regional accrediting association in the US (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

Between 2000 and 2008, enrollment in distance education courses increased rapidly in almost every country in both developed and developing countries (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Many private, public, non-profit, and for-profit institutions worldwide now offer distance education courses from the most basic instruction through to the highest levels of degree and doctoral programs (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). New York University, International University Canada, for example, offers online degrees in engineering and management-related fields through NYU Tandon Online (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Levels of accreditation vary depending on the institution and region (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). For example, widely respected universities such as Stanford University and Harvard now deliver online course (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). However, other online schools receive little outside oversight, and some are actually fraudulent, i.e., diploma mills (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). In the US, the Distance Education Accrediting Commission (DEAC) specializes in the accreditation of distance education institutions (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

In the United States in 2011, there has been a suggestion that a third of all the students enrolled in postsecondary education had taken an accredited online course in a postsecondary institution and growth in this sector has continued (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In 2013 the majority of public and private colleges offered full academic programs online (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Programs included training in the mental health, occupational therapy, family therapy, art therapy, physical therapy, and rehabilitation counseling fields (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). By 2008, online learning programs were available in the United States in 44 states at the K-12 level (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress

and Braswell, 2006). Internet forums, online discussion group and online learning community can contribute to a distance education experience (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Research shows that socialization plays an important role in some forms of distance education (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). E-Courses are available from websites such as Khan Academy and MasterClass on many topics (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The next section tackles the key issue of pacing in distance and online education.

1.4. PACING AND MODELS OF ONLINE EDUCATION

One of the challenges for online education is the task of adopting the right pacing (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). This section examines the two main modalities including paced and self-paced models of online education. Most distance education uses a paced format similar to traditional campus-based models in which learners commence and complete a course at the same time (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Some institutions offer self-paced programs that allow for continuous enrollment, and the length of time to complete the course is set by the learner's time, skill, and commitment levels. Self-paced courses are almost always offered asynchronously (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Each delivery method offers advantages and disadvantages for students, teachers, and institutions (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Figure 1.4 shows a significant global market for self-paced learning.

Figure 1.4: Global market of self-paced e-learning.

Source: TechNavio via Business Wire.

Kaplan and Haenlein classify distance education into four groups according to "Time Dependency" and "Number of Participants" (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). First are the MOOCs which are in effect Open-access online courses (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). These are without specific participation restrictions and therefore allow for unlimited (massive) participation (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). The second category is that of SPOCs (Small Private Online Courses) which is an online course that only offers a limited number of places and therefore requires some form of formal enrollment (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). The third category is that of SMOCs (Synchronous Massive Online Courses) which is an open-access online course that allows for unlimited participation but requires students to be "present" at the same time and therefore operates synchronously (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The 4th category is that of SSOCs (Synchronous Private Online Courses) which are online courses that only offer a limited number of places and require students to be

"present" at the same time or synchronously (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001).

Paced models are a familiar mode since they are used almost exclusively in campus-based schools (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Institutes that offer both distance and campus programs usually use paced models so that teacher workload, student semester planning, tuition deadlines, exam schedules, and other administrative details can be synchronized with campus delivery (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Student familiarity and the pressure of deadlines encourages students to readily adapt to and usually succeed in paced models (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). However, student freedom is sacrificed as a common pace is often too fast for some students and too slow for others (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). In addition; life events, professional or family responsibilities can interfere with a student's capability to complete tasks to an external schedule (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Finally, paced models allow students to readily form communities of inquiry and to engage in collaborative work (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019).

Self-paced courses maximize student freedom, as not only can students commence studies on any date, but they can complete a course in as little time as a few weeks or up to a year or longer (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Students often enroll in self-paced study when they are under pressure to complete programs, have not been able to complete a scheduled course, need additional courses, or have pressure which precludes regular study for any length of time (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The self-paced nature of the programming, though, is an unfamiliar model for many students and can lead to excessive procrastination, resulting in course incompletion (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Assessment of learning can also

be challenging as exams can be written on any day, making it possible for students to share examination questions with resulting loss of academic integrity (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Finally, it is extremely challenging to organize collaborative work activities (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). However, some schools are developing cooperative models based upon networked and connectivist pedagogies for use in self-paced programs (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). In the next section, we will consider the merits of a distance education.

1.5. WHY SELECT DISTANCE EDUCATION?

There are many benefits that are associated with these modalities of distances learning (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). For example, distance learning can expand access to education and training for both general populace and businesses since its flexible scheduling structure lessens the effects of the many time constraints imposed by personal responsibilities and commitments (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Devolving some activities off-site alleviates institutional capacity constraints arising from the traditional demand on institutional buildings and infrastructure (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Furthermore, there is the potential for increased access to more experts in the field and to other students from diverse geographical, social, cultural, economic, and experiential backgrounds (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). As the population at large becomes more involved in lifelong learning beyond the normal schooling age, institutions can benefit financially, and adult learning business courses may be particularly lucrative (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Distance education programs can act as a catalyst for institutional innovation and are at least as effective as face-to-face learning programs, especially if the instructor is knowledgeable and skilled (Sawiuk,

Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The renewed interest in distance education reflects the significant changes in the education industry over the years (see Figure 1.5).

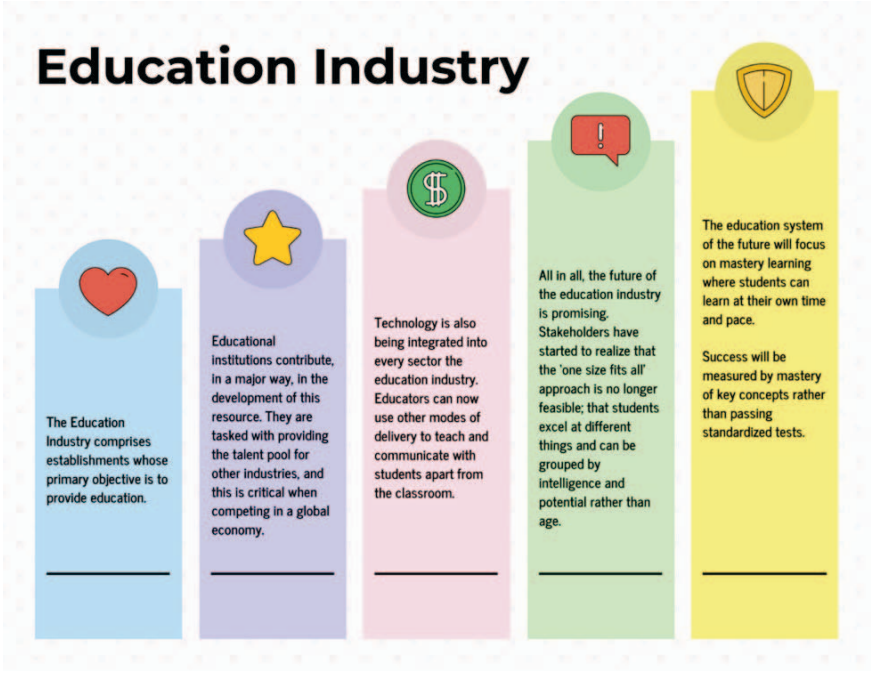

Figure 1.5: Changes in the education industry.

Source: Predictive Analytics Today.

Distance education can provide a broader method of communication within the realm of education (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). With the many tools and programs that technological advancements have to offer, communication appears to increase in distance education amongst students and their professors, as well as students and their classmates (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). The distance educational increase in communication, particularly communication amongst students and their classmates, is an improvement that has been made to provide distance education students with as many of the opportunities as possible as they would receive in in-person education (Spencer, 2014; Stacey, 1999;

Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The improvement being made in distance education is growing in tandem with the constant technological advancements (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Present-day online communication allows students to associate with accredited schools and programs throughout the world that are out of reach for in-person learning (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995).

By having the opportunity to be involved in global institutions via distance education, a diverse array of thought is presented to students through communication with their classmates (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). This is beneficial because students have the opportunity to combine new opinions with their own, and develop a solid foundation for learning (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). It has been shown through research that "as learners become aware of the variations in interpretation and construction of meaning among a range of people through which they construct an individual meaning (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). This in turn can help students become knowledgeable of a wide array of viewpoints in education. To increase the likelihood that students will build effective ties with one another during the course, instructors should use similar assignments for students across different locations to overcome the influence of co-location on relationship building (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

The high cost of education affects students in higher education, to which distance education may be an alternative in order to provide some relief (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Distance education has been a more cost-effective form of learning, and can sometimes save students a significant amount of money as opposed to traditional education (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Distance education may be able to help to save students a considerable amount financially by removing the cost of transportation (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu,

2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). In addition, distance education may be able to save students from the economic burden of high-priced course textbooks (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Many textbooks are now available as electronic textbooks, known as e-textbooks, which can offer digital textbooks for a reduced price in comparison to traditional textbooks (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Also, the increasing improvements in technology have resulted in many school libraries having a partnership with digital publishers that offer course materials for free, which can help students significantly with educational costs (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

Within the class, students are able to learn in ways that traditional classrooms would not be able to provide (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). It is able to promote good learning experiences and, therefore, allow students to obtain higher satisfaction with their online learning (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). For example, students can review their lessons more than once according to their needs (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Students can then manipulate the coursework to fit their learning by focusing more on their weaker topics while breezing through concepts that they already have or can easily grasp (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). When course design and the learning environment are at their optimal conditions, distance education can lead students to higher satisfaction with their learning experiences (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Studies have shown that high satisfaction correlates to increased learning (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). For those in a healthcare or mental health distance learning program, online-based interactions have the potential to foster deeper reflections and discussions of client issues as well as a quicker response to client issues, since supervision happens on a regular basis and is not limited to a weekly supervision meeting (Beaudoin,

2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). This also may contribute to the students feeling a greater sense of support, since they have ongoing and regular access to their instructors and other students (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998).

Distance learning may enable students who are unable to attend a traditional school setting, due to disability or illness such as decreased mobility and immune system suppression, to get a good education (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Children who are sick or are unable to attend classes are able to attend them in "person" through the use of robot proxies (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This helps the students have experiences of the classroom and social interaction that they are unable to receive at home or the hospital, while still keeping them in a safe learning environment (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Over the last few years, more students are entering safely back into the classroom thanks to the help of robots (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Distance education may provide equal access regardless of socioeconomic status or income, area of residence, gender, race, age, or cost per student (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Applying universal design strategies to distance learning courses as they are being developed (rather than instituting accommodations for specific students on an as-needed basis) can increase the accessibility of such courses to students with a range of abilities, disabilities, learning styles, and native languages (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Distance education graduates, who would never have been associated with the school under a traditional system, may donate money to the school (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

Distance learning may also offer a final opportunity for adolescents that are no longer permitted in the general education population due to behavior disorders (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and

Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Instead of these students having no other academic opportunities, they may continue their education from their homes and earn their diplomas, offering them another chance to be an integral part of society (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Distance learning offers individuals a unique opportunity to benefit from the expertise and resources of the best universities currently available (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Students have the ability to collaborate, share, question, infer, and suggest new methods and techniques for continuous improvement of the content (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The ability to complete a course at a pace that is appropriate for each individual is the most effective manner to learn given the personal demands on time and schedule (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Self-paced distance learning on a mobile device, such as a smartphone, provides maximum flexibility and capability for these learners (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). This chapter will close by highlighting some criticism of distance learning.

1.6. CRITICISM OF DISTANCE EDUCATION

A number of criticisms have been leveled at long-distance education and the ways in which it is delivered to learners (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). For example, there are certain barriers to effective distance education such as domestic distractions and unreliable technology (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Other hindrances include students' program costs, adequate contact with teachers and support services, and a need for more experience (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Some students attempt to participate in distance education without proper training with the tools needed to be successful in the program (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Students must be

provided with training opportunities on each tool that is used throughout the program (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The lack of advanced technology skills can lead to an unsuccessful experience (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Schools have a responsibility to adopt a proactive policy for managing technology barriers (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Time management skills and self-discipline in distance education is just as important as complete knowledge of the software and tools being used for learning (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Figure 1.6 highlights some of the challenges that have traditionally been associated with distance education, as opposed to the more traditional forms of education.

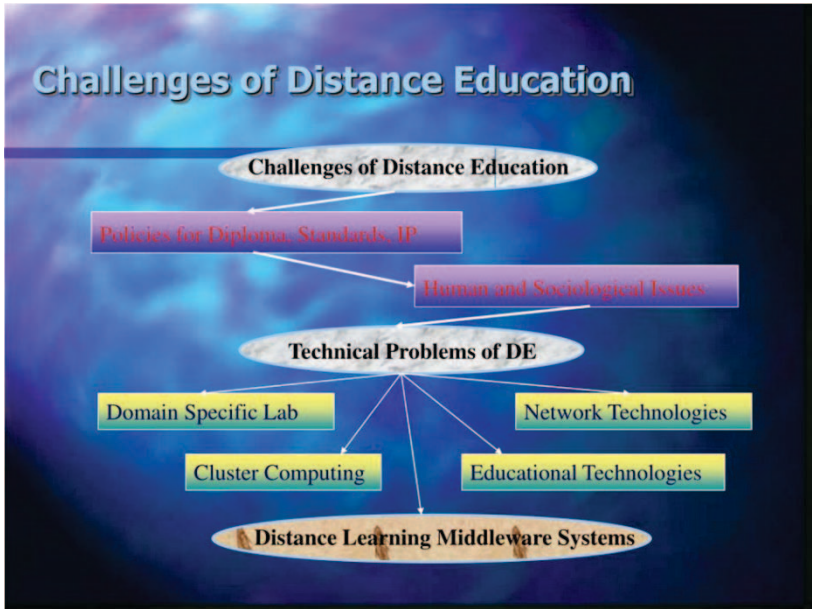

Figure 1.6: Challenges of distance education.

Source: Slide Serve.

The results of a study of Washington state community college students showed that distance learning students tended to drop out more often than their traditional counterparts due to difficulties in language, time

management, and study skills (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). According to Dr. Pankaj Singhm, director of NIMS University argues that all of the obstacles have been overcome and the world environment for distance education continues to improve (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). However, as more people become used to personal and social interaction online (e.g., dating, chat rooms, shopping, or blogging), it is becoming easier for learners to both project themselves and socializes with others (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). This is an obstacle that has dissipated. Not all courses required to complete a degree may be offered online (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Health care profession programs, in particular, require some sort of patient interaction through field work before a student may graduate (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Studies have also shown that students pursuing a medical professional graduate degree who are participating in distance education courses, favor a face-to-face communication over professor-mediated chat rooms and independent studies (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). However, this is little correlation between student performance when comparing the previous different distance learning strategies (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

There is a theoretical problem with the application of traditional teaching methods to online courses because online courses may have no upper size limit (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Daniel Barwick noted that there is no evidence that large class size is always worse or that small class size is always better, although a negative link has been established between certain types of instruction in large classes and learning outcomes (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). He argued that higher education has not made a sufficient effort to experiment with a variety of instructional methods to determine whether the large class size is always negatively correlated with a reduction in learning outcomes (Popovich and

Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Early proponents of MOOCs saw them as just the type of experiment that Barwick had pointed out was lacking in higher education, although Barwick himself has never advocated for MOOCs (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

There may also be institutional challenges that need to be overcome if this modality is to achieve its full potential (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Distance learning is new enough that it may be a challenge to gain support for these programs in a traditional brick-and-mortar academic learning environment (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Furthermore, it may be more difficult for the instructor to organize and plan a distance learning program (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). This is especially true since many are new programs and their organizational needs are different from a traditional learning program (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Additionally, though distance education offers industrial countries the opportunity to become globally informed, there are still negative sides to it (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Hellman states that these include its cost and capital intensiveness, time constraints and other pressures on instructors, the isolation of students from instructors and their peers, instructors' enormous difficulty in adequately evaluating students they never meet face-to-face, and drop-out rates far higher than in classroom-based courses (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

A more complex challenge of distance education relates to cultural differences between students and teachers and among students (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Distance programs tend to be more diverse as they could go beyond the geographical borders of regions, countries, and continents, and cross the cultural borders that may exist with respect to race, gender, and religion (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). That requires a proper understanding and

awareness of the norms, differences, preconceptions, and potential conflicting issues (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The modern use of electronic educational technology (also called e-learning) facilitates distance learning and independent learning by the extensive use of information and communications technology or ICT (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). This has had the effect of replacing traditional content delivery by postal correspondence (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Instruction can be synchronous and asynchronous online communication in an interactive learning environment or virtual communities, in lieu of a physical classroom (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The focus is shifted to the education transaction in the form of a virtual community of learners sustainable across time (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004).

One of the most significant issues encountered in the mainstream correspondence model of distance education is the transactional distance, which results from the lack of appropriate communication between learner and teacher (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This gap has been observed to become wider if there is no communication between the learner and teacher and has direct implications over the learning process and future endeavors in distance education (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Distance education providers began to introduce various strategies, techniques, and procedures to increase the amount of interaction between learners and teachers (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). These measures included more frequent face-to-face tutorials, increased use of information and communication technologies, including teleconferencing and the Internet (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). These were designed to close the gap in transactional distance (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Others have queried the veracity and value of online credentials for learning (Austin and Beaulieu-Brossard, 2018; Bai

et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Online credentials for learning are digital credentials that are offered in place of traditional paper credentials for a skill or educational achievement (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Directly linked to the accelerated development of internet communication technologies, the development of digital badges, electronic passports and MOOCs have a very direct bearing on our understanding of learning, recognition, and levels as they pose a direct challenge to the status quo (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). It is useful to distinguish between three forms of online credentials: Test-based credentials, online badges, and online certificates (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Learners are particularly concerned about the security of these credentials and their value in the job market (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Nevertheless, the impact of COVID-19 pandemics has meant that many traditional universities are moving towards online credentials anyway (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014).

SUMMARY

Distance learning is a modality for allowing learners from all backgrounds to engage in the education sector. The history and examples of distance learning indicate that it is a uniquely inclusive institution. Through the growth of open universities, for example, there have been technological advancements that have spread the reach of distance education well beyond its original conception. A number of tools have been used in distance education, including radio, television, and more recently the internet. It is these modalities that open the sector up, but also lead to rise to concerns about the veracity of the resultant qualifications and credentials. The next chapter in this book will focus on the technologies that have been developed in order to support distance education generally, and more specifically its online versions.

Chapter

2 The Use of Educational Technologies

CONTENTS

Technological advancement has been instrumental in the evolution of the education sector, both in terms of curricula content and pedagogy. This chapter examines the role of educational technologies in the development of distance and online education. In doing so, this chapter will explore the conceptualization of educational technologies. This then leads to a historical review of the major events in the link between education and technology. The third section of this chapter highlights some theories and practice modalities for educational technologies. The penultimate section examines the use of common technologies in education. Finally, the chapter will evaluate the case for standardizing educational technologies. By the end of this chapter, the reader should have a broad view of the origins and uses of contemporary technologies in online education.

2.1. CONCEPTUALIZATION OF EDUCATIONAL TECHNOLOGY

Educational technology (commonly abbreviated as EduTech, or EdTech) is the combined use of computer hardware, software, and educational theory and practice to facilitate learning (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Educational technology creates, uses, and manages technological processes and educational resources to help improve user academic performance (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). The field has been described as a persisting initiative that seeks to bring learners, teacher, and technical means together in an effective way (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). In addition to experiential knowledge drawn from educational practice, educational technology is based on theoretical knowledge that emerges from various disciplines such as communication, education, psychology, sociology, artificial intelligence (AI), and computer science, among others (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). It encompasses several domains including learning theory, computer-based training (CBT), online learning, and m-learning, where mobile technologies are used (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Figure 2.1 shows an example of how a prototype for tablet-

based learning may be designed as part of an overall strategy of introducing educational technologies into the learning environment.

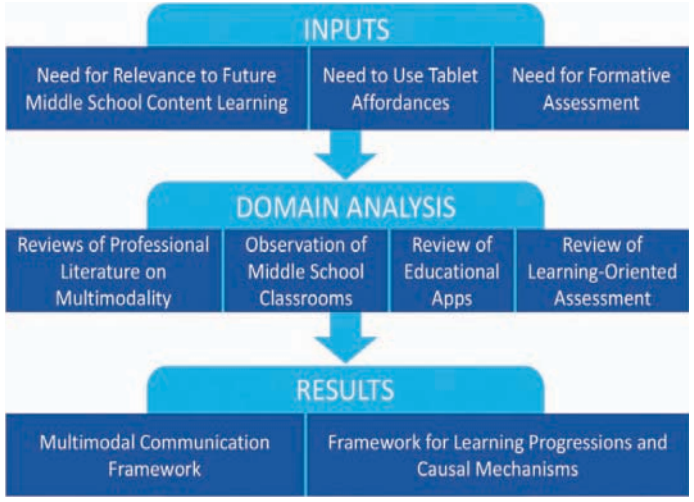

Figure 2.1: Designing a prototype of tablet-based learning.

Source: Wiley Online Library.

The Association for Educational Communications and Technology (AECT) defined educational technology as the study and ethical practice of facilitating learning and improving performance by creating, using, and managing appropriate technological processes and resources (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). It denoted instructional technology as the theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). As such, educational technology refers to all valid and reliable applied education sciences, such as equipment, as well as processes and procedures that are derived from scientific research (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In a given context, educational technology may refer to theoretical, algorithmic or heuristic processes (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). However, it does not necessarily imply physical technology (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Educa-

tional technology is the process of integrating technology into education in a positive manner that promotes a more diverse learning environment and a way for students to learn how to use technology as well as their common assignments (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010).

Accordingly, there are several discrete aspects to describing the intellectual and technical development of educational technology (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). First, educational technology can be conceived as the theory and practice of educational approaches to learning (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Secondly, it comprises technological tools and media, for instance, massive online courses, that assist in the communication of knowledge, and its development and exchange (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). This is usually what people are referring to when they use the term "EdTech" (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Third, educational technology can be utilized for learning management systems (LMS), such as tools for student and curriculum management, and education management information systems or EMIS (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Fourth, educational technology is conceived as back-office management, such as training management systems for logistics and budget management, and learning record store (LRS) for learning data storage and analysis (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Lastly, educational technology itself can be conceived as an educational subject; such courses may be called "computer studies" or "information and communications technology or ICT (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

A number of related or similar terms have emerged around the industry in educational technology (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). For example, educational technology has been defined as an inclusive term for both the material tools and the theoretical foundations for supporting learning and teaching (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000;

Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Educational technology is not restricted to high technology but is anything that enhances classroom learning in the utilization of blended, face to face, or online learning (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). An educational technologist is someone who is trained in the field of educational technology (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Educational technologists try to analyze, design, develop, implement, and evaluate process and tools to enhance learning (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). While the term educational technologist is used primarily in the United States, learning technologist is synonymous and used in the UK as well as Canada (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

Modern electronic educational technology is an important part of society today (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Educational technology encompasses e-learning, instructional technology, information and communication technology (ICT) in education, EdTech, learning technology, multimedia learning, technology-enhanced learning (TEL), and computer-based instruction or CBI (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). It can also encompass computer-managed instruction, CBT, computer-assisted instruction or computer-aided instruction (CAI), internet-based training (IBT), and flexible learning (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Other potential modalities are web-based training (WBT), online education, digital educational collaboration, distributed learning, and computer-mediated communication (CMC) (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Certain literature includes cyber-learning, and multi-modal instruction, virtual education, personal learning environments, and networked learning (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Recently, there has been increased interest in the related concepts of virtual learning environments (VLE) which are also called learning platforms, m-learning, ubiquitous learning and digital education (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and

Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Each of these numerous terms has had its advocates, who point up potential distinctive features (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). However, many terms and concepts in educational technology have been defined nebulously (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). For example, reviews of the literature found a complete lack agreement of the components of a personal learning environment (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Moreover, other researchers saw these terminologies as emphasizing particular features such as digitization approaches, components or delivery methods rather than being fundamentally dissimilar in concept or principle (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). A case in point is how m-learning emphasizes mobility, which allows for altered timing, location, accessibility, and context of learning (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Nevertheless, its purpose and conceptual principles are those of educational technology (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

In practice, as technology has advanced, the particular "narrowly defined" terminological aspect that was initially emphasized by name has blended into the general field of educational technology (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Initially, "virtual learning" as narrowly defined in a semantic sense implied entering an environmental simulation within a virtual world, for example, in treating posttraumatic stress disorder or PTSD (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). In practice, a "virtual education course" refers to any instructional course in which all, or at least a significant portion, is delivered by the Internet (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). "Virtual" is used in that broader way to describe a course that is not taught in a classroom face-to-face but through a substitute mode that can conceptually be associated "virtually" with classroom teaching, which means that people do not have to go to the physical classroom to learn (Austin and Beaulieu-

Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Accordingly, virtual education refers to a form of distance learning in which course content is delivered by various methods such as course management applications, multimedia resources, and videoconferencing (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Virtual education and simulated learning opportunities, such as games or dissections, offer opportunities for students to connect classroom content to authentic situations (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

Educational content, pervasively embedded in objects, is all around the learner, who may not even be conscious of the learning process (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). The combination of adaptive learning, using an individualized interface and materials, which accommodate to an individual, has been termed smart learning (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This is likely to apply to an individual who receives personally differentiated instruction (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Such modalities go hand in hand with ubiquitous access to digital resources and learning opportunities in a range of places and at various times (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Therefore, smart learning is a component of the smart city concept (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). In the next section, we will briefly look at the history of educational technology.

2.2. A BRIEF HISTORY OF EDUCATIONAL TECHNOLOGIES

There is a relatively compact history of educational technologies, but most of the changes happened in the last 50 years (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). However, helping people and children learn in ways that are easier, faster, more accurate, or less expensive can be traced back to the emergence of very early tools, such as paintings on cave walls (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005;

Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Various types of abacus have been used. Writing slates and blackboards have been used for at least a millennium (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). From their introduction, books, and pamphlets have held a prominent role in education (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). From the early twentieth century, duplicating machines such as the mimeograph and Gestetner stencil devices were used to produce short copy runs (typically 10–50 copies) for classroom or home use (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

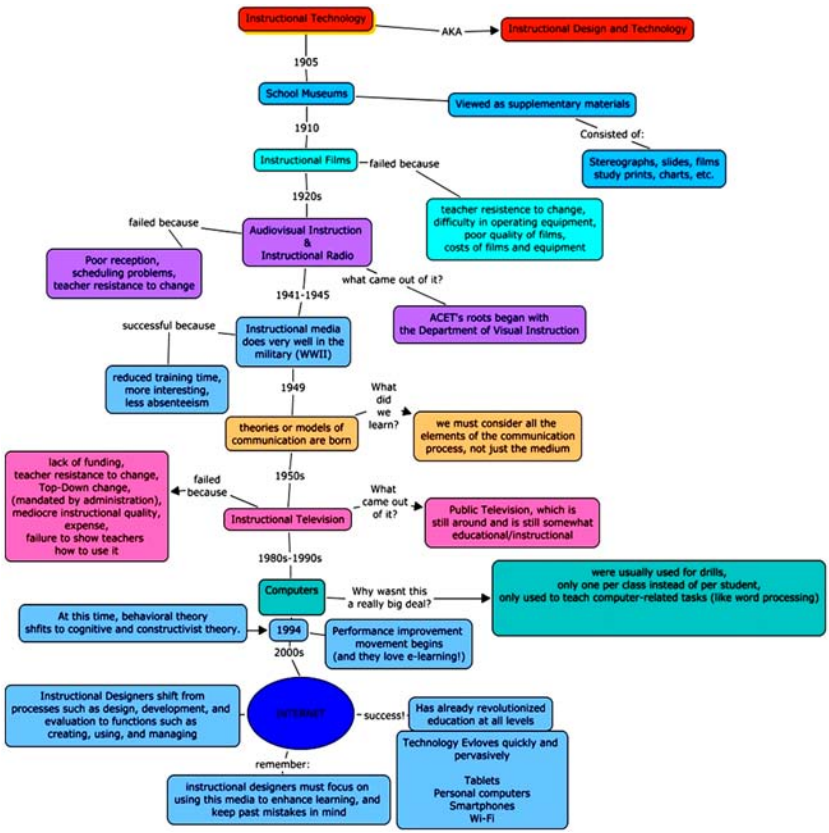

Figure 2.2: History of instructional technologies.

Source: IHMC Public Cmaps.

The use of media for instructional purposes is generally traced back to the first decade of the 20th century with the introduction of educational films (1900s) and Sidney Pressey's mechanical teaching machines which took hold in the 1920s (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Figure 2.2 summarizes the history of educational technology.

The first all multiple choice, large-scale assessment was the Army Alpha, used to assess the intelligence and, more specifically, the aptitudes of World War I military recruits (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Further large-scale use of technologies was employed in training soldiers during and after WWII using films and other mediated materials, such as overhead projectors (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The concept of hypertext is traced to the description of Memex by Vannevar Bush in 1945 (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Slide projectors were widely used during the 1950s in educational institutional settings (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Cuisenaire rods were devised in the 1920s and saw widespread use from the late 1950s (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). In the mid-1960s, Stanford University psychology professors, Patrick Suppes and Richard C. Atkinson, experimented with using computers to teach arithmetic and spelling via Teletypes to elementary school students in the Palo Alto Unified School District in California (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Stanford's Education Program for Gifted Youth is descended from those early experiments (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

Online education originated from the University of Illinois in 1960 (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Although the internet would not be created for another 9 years, students were able to access class information with linked computer terminals (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The first online course was offered in 1986 by the Electronic University

Network for DOS and Commodore 64 computers (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Computer Assisted Learning eventually offered the first online courses with real interaction. In 2002, MIT began providing online classes free of charge (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). As of 2009, approximately 5.5 million students were taking at least one class online (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Currently, one out of three college students takes at least one online course while in college (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). At DeVry University, out of all students that are earning a bachelor's degree, 80% earn two-thirds of their requirements online (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Also, in 2014, 2.85 million students out of 5.8 million students that took courses online, took all of their courses online (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). From this information, it can be concluded that the number of students taking classes online is on the steady increase (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

In 1971, Ivan Illich published a hugely influential book, Deschooling Society, in which he envisioned "learning webs" as a model for people to network the learning they needed (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). The 1970s and 1980s saw notable contributions in computer-based learning (CBL) by Murray Turoff and Starr Roxanne Hiltz at the New Jersey Institute of Technology as well as developments at the University of Guelph in Canada (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). In the UK, the Council for Educational Technology supported the use of educational technology, in particular administering the government's National Development Program in Computer-Aided Learning from 1973 to 1977 and the Microelectronics Education Program from 1980 to 1986 (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). By the mid-1980s, accessing course content became possible at many college libraries (Jansson, Bukuluki, and

Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In CBT or CBL, the learning interaction was between the student and computer drills or micro-world simulations (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

Digitized communication and networking in education started in the mid-1980s (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Educational institutions began to take advantage of the new medium by offering distance learning courses using computer networking for information (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Early e-learning systems, based on CBL or training often replicated autocratic teaching styles whereby the role of the e-learning system was assumed to be for transferring knowledge (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). This was different from the systems developed later based on computer supported collaborative learning (CSCL), which encouraged the shared development of knowledge (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Videoconferencing was an important forerunner to the educational technologies known today (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). This work was especially popular with museum education (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Even in recent years, videoconferencing has risen in popularity to reach over 20,000 students across the United States and Canada in 2008–2009 (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Disadvantages of this form of educational technology are readily apparent (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). For example, image, and sound quality is often grainy or pixelated (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Moreover, videoconferencing requires setting up a type of mini-television studio within the museum for broadcast (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Additionally, space becomes an issue with large productions (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and

Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Furthermore, specialized equipment is required for both the provider and the participant (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

The Open University (OU) in Britain and the University of British Columbia began a revolution of using the internet to deliver learning (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). This involved making heavy use of WBT, online distance learning and online discussion between students (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Practitioners such as Harasim (1995) put heavy emphasis on the use of learning networks (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). With the advent of the World Wide Web in the 1990s, teachers embarked on the method using emerging technologies to employ multi-object-oriented sites (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). These are text-based online virtual reality (VR) systems which are used to create course websites along with simple sets of instructions for its students (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). By 1994, the first online high school had been founded (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In 1997, Graziadei described criteria for evaluating products and developing technology-based courses that include being portable, replicable, scalable, affordable, and having a high probability of long-term cost-effectiveness (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Improved Internet functionality enabled new schemes of communication with multimedia or webcams (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). The National Center for Education Statistics estimate the number of K-12 students enrolled in online distance learning programs increased by 65% from 2002 to 2005 (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). This was accompanied by greater flexibility, ease

of communication between teacher and student, and quick lecture and assignment feedback (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

According to 2008 study conducted by the U.S Department of Education, during the 2006–2007 academic year about 66% of postsecondary public and private schools participating in student financial aid programs offered some distance learning courses (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Moreover, records show that 77% of enrollment in for-credit courses has an online component (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). In 2008, the Council of Europe passed a statement endorsing e-learning's potential to drive equality and education improvements across the EU (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Computer-mediated communication (CMC) is between learners and instructors, mediated by the computer (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). In contrast, computer-based technology or CBL usually means individualized (self-study) learning (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Meanwhile CMC involves educator or tutor facilitation. It inherently requires scenarization of flexible learning activities (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). In addition, modern ICT provides education with tools for sustaining learning communities and associated knowledge management tasks (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Students growing up in this digital age have extensive exposure to a variety of media (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Major high-tech companies have funded schools to provide them the ability to teach their students through technology (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004).

Records indicate that 2015 was the first year that private nonprofit organizations enrolled more online students than for-profits (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). However, public universities still enrolled

the highest number of online students (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). In the fall of 2015, more than 6 million students enrolled in at least one online course (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In 2020, due to the COVID-19 outbreak, many schools are closed, and more and more students are enrolling in online courses to enforce distant learning (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Organizations such as UNESCO have listed educational technology solutions to help schools facilitate distance education (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). The next section will consider the theories behind educational technologies and their use.

2.3. THEORIES AND PRACTICE OF EDUCATIONAL TECHNOLOGIES

A number of theories have emerged or been adapted in order to account for the use of educational technologies in a structured and predictable way (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Various pedagogical perspectives or learning theories may be considered in designing and interacting with educational technology (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). E-learning theory examines these approaches (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). These theoretical perspectives are grouped into three main theoretical schools or philosophical frameworks: behaviorism, cognitivism, and constructivism (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Figure 2.3 demonstrates an example of a technological pedagogical content knowledge framework that is based on some of the theories that are explored in this section.

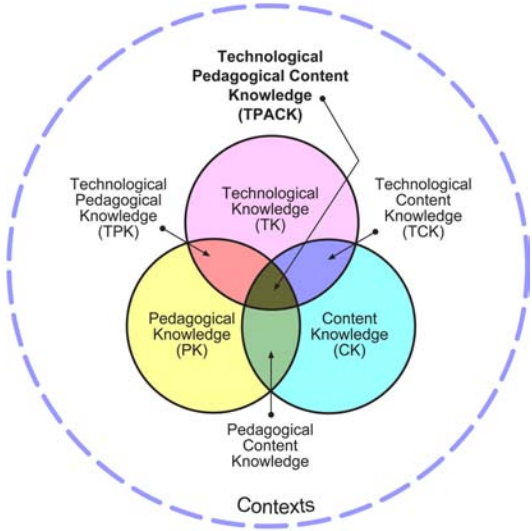

Figure 2.3: Technological pedagogical content knowledge framework.

Source: Educational Technology.

The theoretical framework associated with behaviorism, for example, was developed in the early 20th century based on animal learning experiments by Ivan Pavlov, Edward Thorndike, Edward C. Tolman, Clark L. Hull, and B.F. Skinner (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Many psychologists used these results to develop theories of human learning (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). However, modern educators generally see behaviorism as one aspect of a holistic synthesis (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Teaching in behaviorism has been linked to training, emphasizing the animal learning experiments (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Since behaviorism consists of the view of teaching people how to do something with rewards and punishments, it is related to training people (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). B.F. Skinner wrote extensively on improvements of teaching based on his functional analysis of verbal behavior (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn,

2011; Buzan, Waever, and de Wilde, 1998). For example, "The Technology of Teaching" was an attempt to dispel the myths underlying contemporary education as well as promote his system he called programmed instruction (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Ogden Lindsley developed a learning system, named Celeration (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). This approach was based on behavior analysis but that substantially differed from Keller's and Skinner's models (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

Cognitive science underwent significant change in the 1960s and 1970s to the point that some described the period as a "cognitive revolution" particularly in reaction to behaviorism (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). While retaining the empirical framework of behaviorism, cognitive psychology theories look beyond behavior to explain brain-based learning by considering how human memory works to promote learning (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). It refers to learning as all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" by the human mind (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The Atkinson-Shiffrin memory model and Baddeley's working memory model were established as theoretical frameworks (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Computer Science and Information Technology have had a major influence on Cognitive Science theory (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004).

The Cognitive concepts of working memory (formerly known as short-term memory) and long-term memory have been facilitated by research and technology from the field of Computer Science (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Another major influence on the field of Cognitive Science is Noam Chomsky (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Today researchers are concentrating on topics like cognitive load, information processing,

and media psychology (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). These theoretical perspectives influence instructional design (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). There are two separate schools of cognitivism: the cognitivist and social cognitivist (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). The former focuses on the understanding of the thinking or cognitive processes of an individual while the latter includes social processes as influences in learning besides cognition (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). These two schools, however, share the view that learning is more than a behavioral change but as a mental process used by the learner (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

Educational psychologists distinguish between several types of constructivism (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The first category is individual (or psychological) constructivism, a key example being Piaget's theory of cognitive development (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The second form is that of social constructivism (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). This form of constructivism has a primary focus on how learners construct their own meaning from new information, as they interact with reality and with other learners who bring different perspectives (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Constructivist learning environments require students to use their prior knowledge and experiences to formulate new, related, and adaptive concepts in learning (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Under this framework, the role of the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Constructivist educators must make sure that the prior learning experiences are appropriate and related to the concepts being taught (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek

and Woessmann, 2010). Some researchers suggest that well-structured learning environments are useful for novice learners and that ill-structured environments are only useful for more advanced learners (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Educators utilizing a constructivist perspective may emphasize an active learning environment (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Such an environment may incorporate learner centered problem-based learning, project-based learning, and inquiry-based learning, ideally involving real-world scenarios, in which students are actively engaged in critical thinking activities (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). An illustrative discussion and example can be found in the 1980s deployment of constructivist cognitive learning in computer literacy, which involved programming as an instrument of learning (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016).

Logo, a programming language, embodied an attempt to integrate Piagetian ideas with computers and technology (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Initially, there were broad, hopeful claims, including that it would improve general problem-solving skills across disciplines (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). However, Logo programming skills did not consistently yield cognitive benefits. This was because this system was not as concrete as advocates claimed (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Others claimed that Logo privileged one form of reasoning over all others (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). This made it difficult to apply the thinking activity to non-logo-based activities (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). By the late 1980s, Logo and other similar programming languages had lost their novelty and dominance and were gradually de-emphasized amid criticisms (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The extent to which e-learning assists or replaces other learning and teaching approaches

is variable, ranging on a continuum from none to fully online distance learning (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). A variety of descriptive terms have been employed to categorize the extent to which technology is used (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). For example, "hybrid learning" or "blended learning" may refer to classroom aids and laptops. It may also refer to approaches in which traditional classroom time is reduced but not eliminated, and is replaced with some online learning (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). "Distributed learning" may describe either the e-learning component of a hybrid approach, or fully online distance learning environments (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

CBT refers to self-paced learning activities delivered on a computer or handheld device such as a tablet or smartphone (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). CBT initially delivered content via CD-ROM, and typically presented content linearly, much like reading an online book or manual (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). For this reason, CBT is often used to teach static processes, such as using software or completing mathematical equations (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). CBT is conceptually similar to WBT, which is delivered via the internet using a web browser (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Assessing learning in a CBT is often by assessments that can be easily scored by a computer such as multiple-choice questions, drag-and-drop, radio button, simulation or other interactive means (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Assessments are easily scored and recorded via online software, providing immediate end-user feedback and completion status (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Users are often able to print completion records in the form of certificates (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). CBTs provide learning stimulus beyond traditional learning

methodology from textbook, manual, or classroom-based instruction (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014).

CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can be embedded to enhance the learning (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). However, CBTs pose some learning challenges (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Typically, the creation of effective CBTs requires enormous resources (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). The software for developing CBTs is often more complex than a subject matter expert or teacher is able to use (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The lack of human interaction can limit both the type of content that can be presented and the type of assessment that can be performed and may need supplementation with online discussion or other interactive elements (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

Computer-supported collaborative learning (CSCL) uses instructional methods designed to encourage or require students to work together on learning tasks, allowing social learning (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). CSCL is similar in concept to the terminology, "e-learning 2.0" and "networked collaborative learning" or NCL (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). With Web 2.0 advances, sharing information between multiple people in a network has become much easier and use has increased (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). One of the main reasons for its usage states that it is a breeding ground for creative and engaging educational endeavors (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Learning takes place through conversations about content and grounded interaction about problems and actions (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). This collaborative learning differs from instruction in which the instructor is the principal source

of knowledge and skills (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

The neologism "e-learning 1.0" refers to direct instruction used in early CBL and training systems or CBL (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). In contrast to that linear delivery of content, often directly from the instructor's material, CSCL uses social software such as blogs, social media, wikis, podcasts, cloud-based document portals, and discussion groups and virtual worlds (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). This phenomenon has been referred to as Long Tail Learning (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Advocates of social learning claim that one of the best ways to learn something is to teach it to others (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Social networks have been used to foster online learning communities around subjects as diverse as test preparation and language education (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Mobile-assisted language learning (MALL) is the use of handheld computers or cell phones to assist in language learning (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

Collaborative apps allow students and teachers to interact while studying (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Apps are designed after games, which provide a fun way to revise. When the experience is enjoyable, the students become more engaged (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Games also usually come with a sense of progression, which can help keep students motivated and consistent while trying to improve (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Classroom 2.0 refers to online multi-user virtual environments (MUVEs) that connect schools across geographical frontiers. Known as "eTwinning," computer-supported collaborative learning (CSCL) allows learners in one school to communicate with learners in another that they would not get to know otherwise (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK

Council for International Student Affairs, 2015). This has the desirable effect of enhancing educational outcomes and cultural integration (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010).

A good number of researchers distinguish between collaborative and cooperative approaches to group learning (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). For example, Roschelle, and Teasley (1995) argue that cooperation is accomplished by the division of labor among participants (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). This is conceived as an activity where each person is responsible for a portion of the problem solving (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). The approach stands in contrast to collaboration which involves the mutual engagement of participants in a coordinated effort to solve the problem together (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The flipped classroom is an outcome of the development of all these theories and practice modalities for educational technologies (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). A flipped classroom is an instructional strategy in which computer-assisted teaching is integrated with classroom instruction (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Students are given basic essential instruction, such as lectures, before class instead of during class (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Instructional content is delivered outside of the classroom, often online (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). The out-of-class delivery includes streaming video, reading materials, online chats, and other resources (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This frees up classroom time for teachers to more actively engage with learners (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). The next section highlights some technologies that are commonly used in the classroom.

2.4. THE TECHNOLOGIES COMMONLY USED IN EDUCATION

A number of technologies have been used in the classroom in order to facilitate both teaching and learning (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Educational media and tools can be used for task structuring support (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). They also help with how to do a task (e.g., procedures, and processes) access to knowledge bases such as helping users find information needed (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). This type of technology helps learners and teachers access alternate forms of knowledge representation such as multiple representations of knowledge including video, audio, text, image, and data (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004).

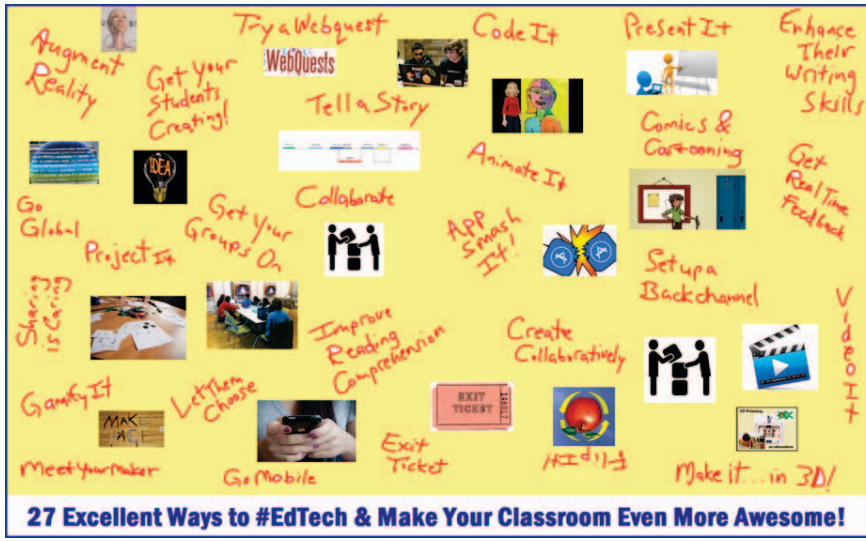

Figure 2.4: Use of technology in education and training.

Source: Emerging EdTech.

Numerous types of physical technology are currently used (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004;

Anderson and Dron, 2011; Aradau, 2004). These typologies include digital cameras, video cameras, interactive whiteboard tools, document cameras, electronic media, and LCD projectors (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Combinations of these techniques include blogs, collaborative software, e-Portfolios, and virtual classrooms (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Figure 2.4 highlights the multitude of ways in which educational technology is deployed for pedagogical purposes.

The current design of this type of applications includes the evaluation through tools of cognitive analysis that allow to identify which elements optimize the use of these platforms (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Video technology has included VHS tapes and DVDs, as well as on-demand and synchronous methods with digital video via server or web-based options such as streamed video and webcams (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Telecommuting can connect with speakers and other experts (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Interactive digital video games are being used at K-12 and higher education institutions (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Radio offers a synchronous educational vehicle, while streaming audio over the internet with webcasts and podcasts can be asynchronous (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Classroom microphones, often wireless, can enable learners and educators to interact more clearly (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Screencasting allows users to share their screens directly from their browser and make the video available online so that other viewers can stream the video directly (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The presenter thus has the ability to show their ideas and flow of thoughts rather than simply explain them as simple text content (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). In combination with audio and video, the educator can mimic the one-

on-one experience of the classroom (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Learners have the ability to pause and rewind, to review at their own pace, something a classroom cannot always offer (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

Webcams and webcasting have enabled creation of virtual classrooms and VLE (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Webcams are also being used to counter plagiarism and other forms of academic dishonesty that might occur in an e-learning environment (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Collaborative learning is a group-based learning approach in which learners are mutually engaged in a coordinated fashion to achieve a learning goal or complete a learning task (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). With recent developments in smartphone technology, the processing powers and storage capabilities of modern mobiles allow for advanced development and the use of apps (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Many app developers and education experts have been exploring smartphone and tablet apps as a medium for collaborative learning (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Computers and tablets enable learners and educators to access websites as well as applications. Many mobile devices support m-learning (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

Mobile devices such as clickers and smartphones can be used for interactive audience response feedback (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Mobile learning can provide performance support for checking the time, setting reminders, retrieving worksheets, and instruction manuals (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Such devices as iPads are used for helping disabled (visually impaired or with multiple disabilities) children in communication development as well as in improving physiological activity, according to the stimulation Practice Report (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006;

Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Computers in the classroom have been shown to increase rates of engagement and interest when computers and smart devices are utilized educationally in classrooms (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

Group webpages, blogs, wikis, and Twitter allow learners and educators to post thoughts, ideas, and comments on a website in an interactive learning environment (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Social networking sites are virtual communities for people interested in a particular subject to communicate by voice, chat, instant message, video conference, or blogs (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The National School Boards Association found that 96% of students with online access have used social networking technologies, and more than 50% talk online about schoolwork (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Social networking encourages collaboration and engagement and can be a motivational tool for self-efficacy amongst students (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

There are three types of whiteboards that have been used in educational settings (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The initial whiteboards, analogous to blackboards, date from the late 1950s (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The term whiteboard is also used metaphorically to refer to virtual whiteboards in which computer software applications simulate whiteboards by allowing writing or drawing (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). This is a common feature of groupware for virtual meetings, collaboration, and instant messaging (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Interactive whiteboards allow learners and instructors to write on the touch screen (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The screen markup can be on either a blank whiteboard or any computer screen content

(Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Depending on permission settings, this visual learning can be interactive and participatory, including writing and manipulating images on the interactive whiteboard (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006).

A VLE, also known as a learning platform, simulates a virtual classroom or meetings by simultaneously mixing several communication technologies (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Web conferencing software enables students and instructors to communicate with each other via webcam, microphone, and real-time chatting in a group setting (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Participants can raise hands, answer polls or take tests (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Students are able to whiteboard and screencast when given rights by the instructor, who sets permission levels for text notes, microphone rights and mouse control (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). A virtual classroom provides an opportunity for students to receive direct instruction from a qualified teacher in an interactive environment (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Learners can have direct and immediate access to their instructor for instant feedback and direction (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The virtual classroom provides a structured schedule of classes, which can be helpful for students who may find the freedom of asynchronous learning to be overwhelming (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). In addition, the virtual classroom provides a social learning environment that replicates the traditional "brick and mortar" classroom (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Most virtual classroom applications provide a recording feature (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995).

Each class is recorded and stored on a server, which allows for instant playback of any class over the course of the school year (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti,

2009; British Future and Universities UK 2014). This can be extremely useful for students to retrieve missed material or review concepts for an upcoming exam (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Parents and auditors have the conceptual ability to monitor any classroom to ensure that they are satisfied with the education the learner is receiving (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). In higher education especially, a VLE is sometimes combined with a management information system (MIS) to create a managed learning environment (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). This is where all aspects of a course are handled through a consistent user interface throughout the institution (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Physical universities and newer online-only colleges offer select academic degrees and certificate programs via the Internet (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Some programs require students to attend some campus classes or orientations, but many are delivered completely online (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Several universities offer online student support services, such as online advising and registration, e-counseling, online textbook purchases, student governments and student newspapers (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004).

Augmented reality (AR) provides students and teachers with the opportunity to create layers of digital information, including both virtual world and real-world elements, to interact within real-time (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). AR technology plays an important role in the future of the classroom where human or AI co-orchestration takes place seamlessly (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Students would switch between individual and collaborative learning dynamically (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). This was based on their own learning pace (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson,

Kulaksiz, and Lithner, 2016). Meanwhile teachers, with the help of AR, monitor the classroom and provide necessary interventions in cases where computer systems are not yet designed to handle (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). In this vision, the technology's role is to enhance, rather than replace, human teachers' capabilities (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014).

A LMS is software used for delivering, tracking, and managing training and education (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). It tracks data about attendance, time on task, and student progress (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Educators can post announcements, grade assignments, check on course activity, and participate in class discussions (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Students can submit their work, read, and respond to discussion questions, and take quizzes (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). An LMS may allow teachers, administrators, students, and permitted additional parties (such as parents, if appropriate) to track various metrics (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). LMSs range from systems for managing training/educational records to software for distributing courses over the internet and offering features for online collaboration (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). The creation and maintenance of comprehensive learning content require substantial initial and ongoing investments of human labor (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Effective translation into other languages and cultural contexts requires even more investment by knowledgeable personnel (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

Internet-based LMSs include Canvas, Blackboard Inc. and Moodle (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). These types of LMS allow educators to run a learning system partially or fully online,

asynchronously or synchronously (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). LMSs also offer a non-linear presentation of content and curricular goals, giving students the choice of pace and order of information learned (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Blackboard can be used for K-12 education, Higher Education, Business, and Government collaboration (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Moodle is a free-to-download Open-Source Course Management System that provides blended learning opportunities as well as platforms for distance learning courses (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007).

A learning content management system (LCMS) is software for author content such as courses and reusable content objects (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The LCMS may be solely dedicated to producing and publishing content that is hosted on an LMS, or it can host the content itself (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The Aviation Industry Computer-Based Training Committee (AICC) specification provides support for content that is hosted separately from the LMS (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019).

Computer-aided assessment (e-assessment) ranges from automated multiple-choice tests to more sophisticated systems (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). With some systems, feedback can be geared towards a student's specific mistakes (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Alternatively, the computer can navigate the student through a series of questions adapting to what the student appears to have learned or not learned (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Formative assessment sifts out the incorrect answers, and these questions are then explained by the teacher (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The learner then practices with slight variations of the

sifted-out questions (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). The process is completed by summative assessment using a new set of questions that only cover the topics previously taught (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). A training management system or training resource management system is a software designed to optimize instructor-led training management (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Similar to an enterprise resource planning (ERP), it is a back-office tool which aims at streamlining every aspect of the training process (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Some of the aspects that are addressed in this way include planning which incorporates training plan and budget forecasting activities (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). They may be used for logistics in terms of scheduling and resource management (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). The aspect of financials includes cost tracking and profitability (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Another general use is that of reporting issues such as sales for-profit training providers (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). A training management system can be used to schedule instructors, venues, and equipment through graphical agendas, optimize resource utilization, create a training plan and track remaining budgets, generate reports and share data between different teams (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). While training management systems focus on managing instructor-led training, they can complete an LMS (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). In this situation, an LMS will manage e-learning delivery and assessment, while a training management system will manage ILT and back-office budget planning, logistics, and reporting (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). This chapter will close with an examination of the opportunities for standardizing educational technologies.

2.5. STANDARDIZATION OF EDUCATIONAL TECHNOLOGIES

The standardization of educational technologies is desirable because it allows for evaluation on an equal footing with a view to raising standards across the board (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Specifically, standardization allows us to distinguish effective systems from less effective ones (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). It is important to distinguish between pedagogical and non-pedagogical aspects of modern technology in order to use these facilities efficiently (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Pedagogical elements are defined as structures or units of educational material (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). They are the educational content that is to be delivered (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). These units are independent of format, meaning that although the unit may be delivered in various ways (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

Some of these modalities include the pedagogical structures themselves which are not the textbook, web page, video conference, Podcast, lesson, assignment, multiple-choice question, quiz, discussion group or a case study (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). The latter are all possible methods of delivery which are important for the efficient process of educating and learning (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). In Figure 2.5 we see that not only is technology an important modality, but also an important goal of sustainable development (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014).

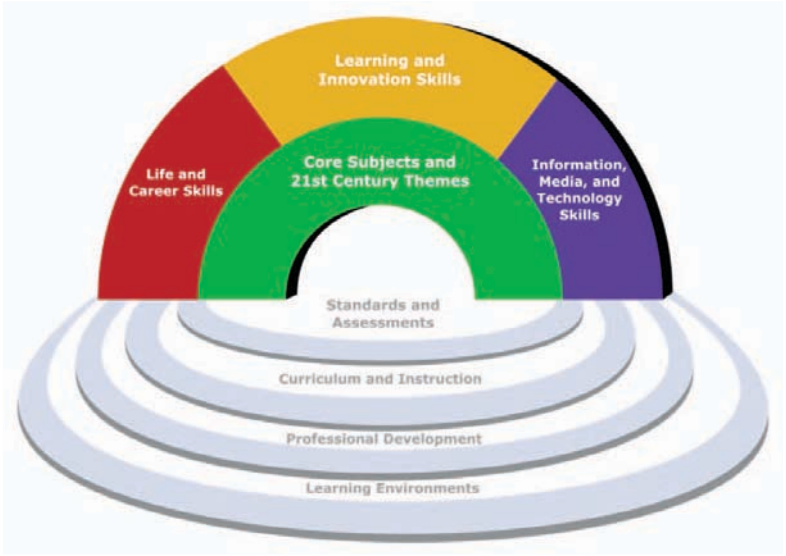

Figure 2.5: Framework for 21st century skills.

Source: Wikipedia.

Much effort has been put into the technical reuse of electronically based teaching materials and, in particular, creating or re-using learning objects (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). These are self-contained units that are properly tagged with keywords or other metadata, and often stored in an XML file format (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Creating a course requires putting together a sequence of learning objects (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). There are both proprietary and open, non-commercial, and commercial, peer-reviewed repositories of learning objects such as the Merlot repository (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Sharable content object reference model (SCORM) is a collection of standards and specifications that applies to certain web-based e-learning (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Other specifications, such as Schools Interoperability Framework, allow for the transporting of learning objects, or for categorizing metadata (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017;

Lillyman and Bennett, 2014). As AI becomes more prominent in this age of big data, it has also been widely adopted in K-12 classrooms (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). One prominent class of AI-enhanced educational technology is intelligent tutoring systems (ITSs), designed to provide immediate and personalized feedback to students (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The incentive to develop ITS comes from educational studies showing that individual tutoring is much more effective than group teaching, in addition to the need for promoting learning on a larger scale (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Over the years, a combination of cognitive science theories and data-driven techniques have greatly enhanced the capabilities of ITS (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). This has been instrumental in allowing it to model a wide range of students' characteristics, such as knowledge, affect, off-task behavior, and wheel-spinning (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). There is ample evidence that ITSs are highly effective in helping students learn (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010).

Recent works have also focused on developing AI-enhanced learning tools that supports human teachers in coordinating classroom activities (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). The teacher can support students in a way that AI cannot, but is unable to process the large amount of real-time data analytics provided by the computer system (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). On the other hand, AI can share the workload and recommend the best course of actions (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). For instance, it can be helpful by pointing out which students require the most help (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). However, AI can only operate in the pre-specified domain and cannot handle tasks such as providing emotional support or remedial lessons to students in need (Vasagar, 2011; Walsh, Ozaeta, and

Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). However, existing systems were designed under the assumption that students' progress at the same pace (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Understanding how to support teachers in a realistic, highly differentiated, self-paced classroom, remains an open research problem (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

Various forms of electronic media can be a feature of preschool life (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Although parents report a positive experience, the impact of such use has not been systematically assessed (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). The age when a given child might start using a particular technology such as a cellphone or computer might depend on matching a technological resource to the recipient's developmental capabilities (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Examples include the age-anticipated stages labeled by Jean Piaget (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Parameters (e.g., age-appropriateness, coherence with sought-after values, and concurrent entertainment and educational aspects) have been suggested for choosing media (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

At the preschool level, technology can be introduced in several ways (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). At the most basic is the use of computers, tablets, and audio and video resources in classrooms (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Additionally, there are many resources available for parents and educators to introduce technology to young children or to use technology to augment lessons and enhance learning (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Some options that are age-appropriate are video or audio-recording of their creations (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al.,

2019). These are tasked with introducing learners to the use of the internet through browsing age-appropriate websites (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). They are also credited with providing assistive technology to allow differently-abled children to participate with the rest of their peers (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The modalities make use of educational apps, electronic books, and educational videos (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). There are many free and paid educational website and apps that are directly targeting the educational needs of preschool children (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). These include Starfall, ABC mouse, PBS Kids Video, Teachme, and Montessori crosswords (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015).

Educational technology in the form of electronic books offer preschool children the option to store and retrieve several books on one device (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). This helps in bringing together the traditional action of reading along with the use of educational technology (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Educational technology is also thought to improve hand-eye coordination, language skills, visual attention, and motivation to complete educational tasks (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). In this way, technological advancement allows children to experience things they otherwise wouldn't (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

There are several keys to making the most educational use out of introducing technology at the preschool level (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). First, technology must be used appropriately. Second, it should allow access to learning opportunities (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Third, it should include the interaction of parents

and other adults with the preschool children (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Fourth, the technology being used should be developmentally appropriate (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

This type of technology has been credited with allowing access to learning opportunities especially for allowing disabled children to have access to learning opportunities (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Another function that it plays is in giving bilingual children the opportunity to communicate and learn in more than one language (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Over time, this technology has been strategically used for bringing in more information about STEM subjects (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). From a social inclusion perspective, this learning modality has been responsible for bringing in images of diversity that may be lacking in the child's immediate environment (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

E-learning is utilized by public K-12 schools in the United States as well as private schools (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Some e-learning environments take place in a traditional classroom; others allow students to attend classes from home or other locations (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). There are several states that are utilizing virtual school platforms for e-learning across the country that continue to increase (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Virtual school enables students to log into synchronous learning or asynchronous learning courses anywhere there is an internet connection (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

E-learning is increasingly being utilized by students who may not want to go to traditional brick and mortar schools (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). This may be due to severe allergies

or other medical issues (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Others may opt for this type of learning due to fear of school violence and school bullying (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Others comprise of students whose parents would like to homeschool but do not feel qualified (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Online schools create a haven for students to receive a quality education while almost completely avoiding these common problems (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Online charter schools also often are not limited by location, income level or class size in the way brick and mortar charter schools are (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

E-learning also has been rising as a supplement to the traditional classroom (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Students with special talents or interests outside of the available curricula use e-learning to advance their skills or exceed grade restrictions (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Some online institutions connect students with instructors via web conference technology to form a digital classroom (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). National private schools are also available online (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). These provide the benefits of e-learning to students in states where charter online schools are not available (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). They also may allow students greater flexibility and exemption from state testing (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Some of these schools are available at the high school level and offer college prep courses to students (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Virtual education in K-12 schooling often refers to virtual schools, and in higher education to virtual universities (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Virtual schools

are "cyber charter schools" with innovative administrative models and course delivery technology (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014).

Students appreciate the convenience of e-learning, but report greater engagement in face-to-face learning environments (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Colleges and universities are working towards combating this issue by utilizing WEB 2.0 technologies as well as incorporating more mentorships between students and faculty members (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). According to James Kulik, students usually learn more in less time when receiving computer-based instruction, and they like classes more and develop more positive attitudes toward computers in computer-based classes (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Students can independently solve problems (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). There are no intrinsic age-based restrictions on difficulty level, and hence students can go at their own pace (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Students editing their written work on word processors improve the quality of their writing (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001).

According to some studies, the students are better at critiquing and editing written work that is exchanged over a computer network with students they know (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Studies completed in "computer intensive" settings found increases in student-centric, cooperative, and higher-order learning, writing skills, problem solving, and using technology (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). In addition, attitudes toward technology as a learning tool by parents, students, and teachers are also improved (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Employers' acceptance of online education has risen over time (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). More than 50%

of human resource managers SHRM surveyed for an August 2010 report said that if two candidates with the same level of experience were applying for a job, it would not have any kind of effect whether the candidate's obtained degree was acquired through an online or a traditional school (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Around 79% said they had employed a candidate with an online degree in the past 12 months (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). However, 66% said candidates who get degrees online were not seen as positively as a job applicant with traditional degrees (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

The use of educational apps generally has a positive effect on learning (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Pre- and post-tests have revealed that the use of educational apps on mobile devices reduces the achievement gap between struggling and average students (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Some educational apps improve group work by allowing students to receive feedback on answers and promoting collaboration in solving problems (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). The benefits of app-assisted learning have been exhibited in all age groups (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Kindergarten students that use iPads show much higher rates of literacy than non-users (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Medical students at University of California Irvine that utilized iPad academically have been reported to score 23% higher on national exams than previous classes that did not (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

SUMMARY

This chapter has explored the conceptualization of educational technologies as a more effective way of imparting knowledge to learners. The process

of learning and teaching takes place within the context of ever-changing educational technologies. That means that the theory and practice of using these technologies has had to be reviewed and reviewed over time. One of the key emerging issues is quality and standardization has been one of the potential ways of achieving this goal. The next chapter critiques the use of educational technology.

Chapter

3 Critique of Technology in Education

CONTENTS

The use of educational technology is not without its critics in terms of its efficiency and appropriateness. This chapter examines some of the criticisms, including its failure to properly account for social-cultural diversity. Another potential criticism is that of enhancing the digital divide that leaves many behind. Others question whether its instrumentality is as efficient as once thought. Moreover, there is concern that there may be certain long-term impacts that are not yet fully understood but which might harm both teachers and learners. The last criticisms that will be explored in this chapter relate to the structures and infrastructure that are associated with educational technology. By the end of this chapter, the reader should have a more nuanced view of educational technology based on its merits as well as its demerits.

3.1. A SOCIAL AND CULTURAL CRITIQUE OF SIMULATED LEARNING

From a social and cultural perspective, there are many disadvantages that are associated with using educational technologies (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Globally, factors like change management, technology obsolescence, and vendor-developer partnership are major restraints that are hindering the growth of the Educational technology market (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). In the US state, and the federal government increased funding, as well as private venture capital has been flowing into education sector (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). However, as of 2013, none were looking at technology return on investment (ROI) to connect expenditures on technology with improved student outcomes (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). In the pursuit of authentic learning (see Figure 3.1), educational technologies do not always play an effective facilitative role (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Instead, they can be debilitated if not selected and used appropriately (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

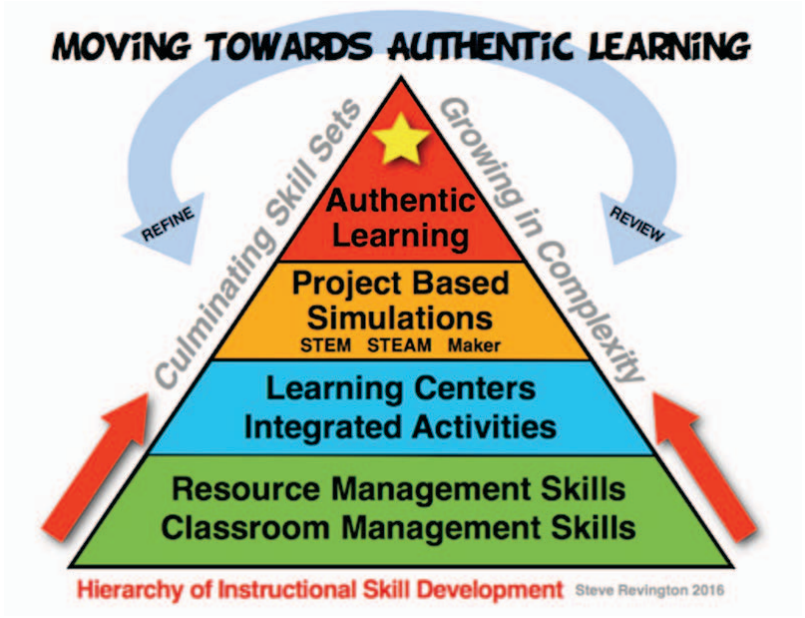

Figure 3.1: Towards authentic learning.

Source: Steve Revington (2016) via Weebly.

New technologies are frequently accompanied by unrealistic hype and promise regarding their transformative power to change education for the better or in allowing better educational opportunities to reach the masses (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Examples include silent film, broadcast radio, and television, none of which have maintained much of a foothold in the daily practices of mainstream, formal education (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Technology, in and of itself, does not necessarily result in fundamental improvements to educational practice (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). The focus needs to be on the learner's interaction with technology and not the technology itself. It needs to be recognized as "ecological" rather than "additive" or "subtractive" (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In this ecological change, one significant change will create total change (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al.,

2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). According to some researchers, technology does not guarantee effective learning and moreover, inappropriate use of technology can even hinder it (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). A University of Washington study of infant vocabulary shows that it is slipping due to educational baby DVDs (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Published in the Journal of Pediatrics, 2007 University of Washington study on the vocabulary of babies surveyed over 1,000 parents in Washington and Minnesota (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The study found that for every one hour that babies 8–16 months of age watched DVDs and Videos, they knew 6–8 fewer of 90 common baby words than the babies that did not watch them (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Meltzoff, a surveyor in this study, states that the result makes sense, that if the baby's "alert time" is spent in front of DVDs and TV, instead of with people speaking, the babies are not going to get the same linguistic experience (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Chistakis, another surveyor, reported that the evidence is mounting that baby DVDs are of no value and may be harmful (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

Adaptive instructional materials tailor questions to each student's ability and calculate their scores (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). However, this encourages students to work individually rather than socially or collaboratively (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Yet, social relationships are important in learning, practice, and employment (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Besides, high-tech environments may compromise the balance of trust, care, and respect between teacher and student (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Massively open online courses (MOOCs), are quite popular in discussions of technology and education in developed countries (Bogo et

al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). This is more so in the USA than other developed countries (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). However, massive online courses are not a major concern in most developing or low-income countries (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006).

One of the stated goals of MOOCs is to provide less fortunate populations (i.e., in developing countries) an opportunity to experience courses with US-style content and structure (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). However, research shows only 3% of the registrants are from low-income countries (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Whereas many courses have thousands of registered students, only 5–10% of them complete the course (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). MOOCs also implies that certain curriculum and teaching methods are superior (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). This could eventually wash over (or possibly washing out) local educational institutions, cultural norms and educational traditions (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). It is in effect an indirect continuation of cultural appropriate and post-colonial hegemony (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

With the internet and social media, using educational apps makes the students highly susceptible to distraction and sidetracking (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Even though proper use has shown to increase student performances, being distracted would be detrimental (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Another disadvantage is an increased potential for cheating. Smartphones can be very easy to hide and use inconspicuously, especially if their use is normalized in the classroom (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith,

and Rangaswamy, 2003). These disadvantages can be managed with strict rules and regulations on mobile phone use (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

Electronic devices such as cellphones and computers facilitate rapid access to a stream of sources, each of which may receive cursory attention (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Students have always faced distractions (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). However, computers and cellphones are a particular challenge because the stream of data can interfere with focusing and learning (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Although these technologies affect adults too, young people may be more influenced by it as their developing brains can easily become habituated to switching tasks and become unaccustomed to sustaining attention (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Too much information, coming too rapidly, can overwhelm thinking (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019).

Technology is rapidly and profoundly altering our brains. High exposure levels stimulate brain cell alteration and release neurotransmitters (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). This causes the strengthening of some neural pathways and weakening of others (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). One consequence is heightened stress levels on the brain that, at first, boost energy levels (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). However, over time, these changes actually augment memory, impair cognition, lead to depression, alter the neural circuitry of the hippocampus, amygdala, and prefrontal cortex (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). These are the brain regions that control mood and thought (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

If unchecked, the underlying structure of the brain could be altered (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Over-stimulation due to technology may begin too young (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). When children are exposed before the age of seven, important developmental tasks may be delayed, and bad learning habits might develop (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). This deprives children of the exploration and plays that they need to develop (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Media psychology is an emerging specialty field that embraces electronic devices and the sensory behaviors occurring from the use of educational technology in learning (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010).

According to Lai, the learning environment is a complex system where the interplay and interactions of many things impact the outcome of learning (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). When technology is brought into an educational setting, the pedagogical setting changes in that technology-driven teaching can change the entire meaning of an activity without adequate research validation (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). If technology monopolizes an activity, students can begin to develop the sense that life would scarcely be thinkable without technology (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Leo Marx considered the word "technology" itself as problematic (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). This was because technology was susceptible to reification and "phantom objectivity" (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Such approaches conceal technology's fundamental nature as something that is only valuable insofar as it benefits the human condition (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001).

Technology ultimately comes down to affecting the relations between people (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008;

Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). However, this notion is obfuscated when technology is treated as an abstract notion devoid of good and evil (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Langdon Winner makes a similar point by arguing that the underdevelopment of the philosophy of technology leaves us with an overly simplistic reduction in our discourse to the supposedly dichotomous notions of the "making" versus the "uses" of new technologies (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Consequently, a narrow focus on "use" leads us to believe that all technologies are neutral in moral standing (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). According to these criticisms, there is too much focus on the ways in which the use of technology can be maximized (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Yet, other believe that the real question is whether the world can sustain and justify the consequences of technology in education (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004).

Some researchers viewed technology as a "form of life" that not only aids human activity, but that also represents a powerful force in reshaping that activity and its meaning (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). For example, the use of robots in the industrial workplace may increase productivity, but they also radically change the process of production itself, thereby redefining what is meant by "work" in such a setting (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). In education, standardized testing has arguably redefined the notions of learning and assessment (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). We rarely explicitly reflect on how strange a notion it is that a number between, say, 0 and 100 could accurately reflect a person's knowledge about the world (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). According to some literature, the recurring patterns in everyday life tend to become an unconscious process that we learn to take for granted (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In the

next section, we consider the role of educational technology in the digital divide.

3.2. THE DIGITAL DIVIDE AND ASSESSMENT

The concept of the digital divide is a gap between those who have access to digital technologies and those who do not (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Access may be associated with age, gender, socio-economic status, education, income, ethnicity, and geography (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). According to a report by the Electronic Frontier Foundation, large amounts of personal data on children are collected by electronic devices that are distributed in schools in the United States (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Often, far more information than necessary is collected, uploaded, and stored indefinitely (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Aside name and date of birth, this information can include the child's browsing history, search terms, location data, contact lists, as well as behavioral information (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Parents are not informed or, if informed, have little choice (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). According to the report, this constant surveillance resulting from educational technology can warp children's privacy expectations, lead them to self-censor, and limit their creativity (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

In 2018, public service announcement, the FBI warned that widespread collection of student information by educational technologies, including web browsing history, academic progress, medical information, and biometrics, created the potential for privacy and safety threats if such data was compromised or exploited (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Figure 3.2 shows some of the aspects of the digital divide which can worsen the inequalities that currently exist within society (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and

Akhiruyanto, 2019; Ladson-Billings, 1995). It is imperative to understand and acknowledge these inequalities so that they can be addressed through corrective action (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014).

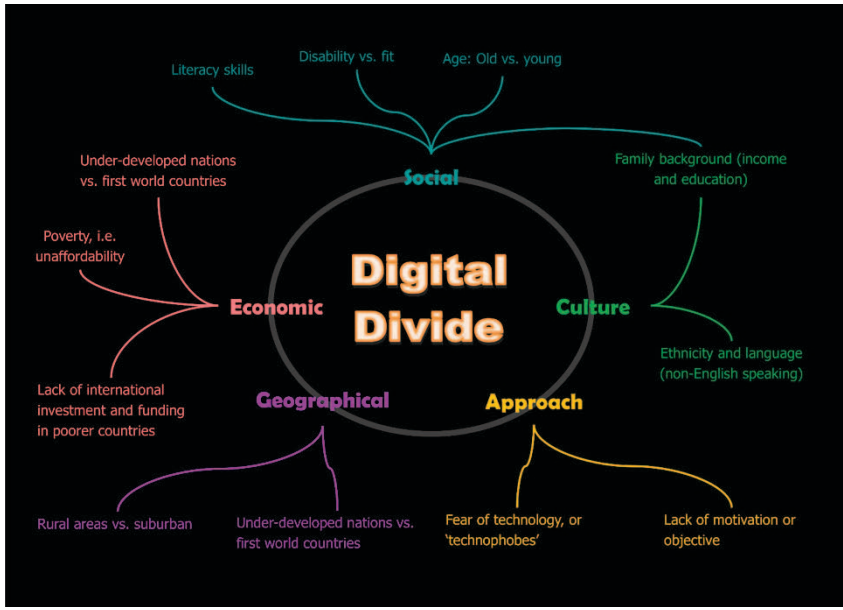

Figure 3.2: The digital divide.

Source: Medium.

Since technology is not the end goal of education, but rather a means by which it can be accomplished, educators must have a good grasp of the technology and its advantages and disadvantages (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Teacher training aims for effective integration of classroom technology (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The evolving nature of technology may unsettle teachers, who may experience themselves as perpetual novices (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Finding quality materials to support classroom objectives is often difficult. Random professional development days are inadequate (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Some researchers

suggest that rather than dealing with each technology in isolation, we would do better to take an ecological approach (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). This involves thinking about the interrelationship among different communication technologies, the cultural communities that grow up around them, and the activities they support (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

Others also suggest that the traditional school curriculum guided teachers to train students to be autonomous problem solvers (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). However, today's workers are increasingly asked to work in teams, drawing on different sets of expertise, and collaborating to solve problems (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Learning styles and the methods of collecting information have evolved, and students often feel locked out of the worlds described in their textbooks through the depersonalized and abstract prose used to describe them (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). These 21st-century skills can be attained through the incorporation and engagement with technology (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Changes in instruction and use of technology can also promote a higher level of learning among students with different types of intelligence (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015).

Educational assessment with technology may be either formative assessment or a summative assessment (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Instructors use both types of assessments to understand student progress and learning in the classroom (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Technology has helped teachers create better assessments to help understand where students who are having trouble with the material are having issues (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Formative assessment is more difficult, as the perfect form is ongoing

and allows the students to show their learning in different ways depending on their learning styles (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Technology has helped some teachers make their formative assessments better, particularly through the use of classroom response systems or CRS (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). A CRS is a tool in which the students each have a hand-held device that partners up with the teacher's computer (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The instructor then asks multiple choice or true or false questions and the students answer on their device (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Depending on the software used, the answers may then be shown on a graph so students and teacher can see the percentage of students who gave each answer and the teacher can focus on what went wrong (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004).

Summative assessments are more common in classrooms and are usually set up to be more easily graded, as they take the form of tests or projects with specific grading schemes (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). One huge benefit to tech-based testing is the option to give students immediate feedback on their answers (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). When students get these responses, they are able to know how they are doing in the class which can help push them to improve or give them confidence that they are doing well (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Technology also allows for different kinds of summative assessment, such as digital presentations, videos, or anything else the teacher or students may come up with, which allows different learners to show what they learned more effectively (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Teachers can also use technology to post graded assessments online for students to have a better idea of what a good project is (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

Electronic assessment uses information technology (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). It encompasses several potential applications, which may be teacher or student-oriented, including educational assessment throughout the continuum of learning, such as computerized classification testing, computerized adaptive testing, student testing, and grading an exam (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). E-Marking is an examiner led activity closely related to other e-assessment activities such as e-testing, or e-learning which are student-led (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). E-marking allows markers to mark a scanned script or online response on a computer screen rather than on paper (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). There are no restrictions on the types of tests that can use e-marking, with e-marking applications designed to accommodate multiple choice, written, and even video submissions for performance examinations (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). E-marking software is used by individual educational institutions and can also be rolled out to the participating schools of awarding exam organizations (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). E-marking has been used to mark many well known high stakes examinations, which in the United Kingdom include A levels and GCSE exams, and in the US includes the SAT test for college admissions (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Ofqual reports that e-marking is the main type of marking used for general qualifications in the United Kingdom (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). In 2014, the Scottish Qualifications Authority (SQA) announced that most of the National 5 question papers would be e-marked (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). In June 2015, the Odisha state government in India announced that it planned to use e-marking for all Plus II papers from 2016 (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). The next section considers the instrumentality of educational technology.

3.3. INSTRUMENTALITY OF EDUCATIONAL SOFTWARE

There are many areas in which the instrumentality of educational technology is of paramount importance (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). One of those areas is that of analytics (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The importance of self-assessment through tools made available on Educational Technology platforms has been growing (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Self-assessment in education technology relies on students analyzing their strengths, weaknesses, and areas where improvement is possible to set realistic goals in learning, improve their educational performances and track their progress (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998).

One of the unique tools for self-assessment made possible by education technology is Analytics (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Analytics is data gathered on the student's activities on the learning platform, drawn into meaningful patterns that lead to a valid conclusion, usually through the medium of data visualization such as graphs (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Learning analytics is the field that focuses on analyzing and reporting data about student's activities in order to facilitate learning (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Figure 3.3 is an example of an ICT (Information and Computer Technology) framework that uses educational technology as an instrumentality towards achieving wider societal and organization goals (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

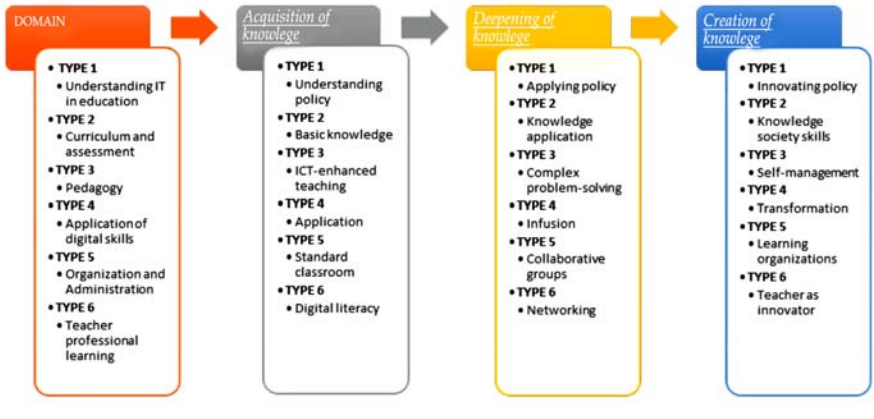

Figure 3.3: ICT competency framework.

Source: Adapted from UNESCO.

Another arena in which educational technology is important is that of commerce and the control of expenditure patterns (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). The five key sectors of the e-learning industry are consulting, content, technologies, services, and support (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Worldwide, e-learning was estimated in 2000 to be over $48 billion according to conservative estimates (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Commercial growth has been brisk (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). In 2014, the worldwide commercial market activity was estimated at $6 billion venture capital over the past 5 years, with self-paced learning generating $35.6 billion in 2011 (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). North American e-learning generated $23.3 billion in revenue in 2013, with a 9% growth rate in cloud-based authoring tools and learning platforms (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

Educational technologists and psychologists apply basic educational and psychological research into an evidence-based applied science (or a

technology) of learning or instruction (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). In research, these professions typically require a graduate degree (Master's, Doctorate, PhD, or DPhil) in a field related to educational psychology, educational media, experimental psychology, cognitive psychology or, more purely, in the fields of educational, instructional or human performance technology or instructional design (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). In industry, educational technology is utilized to train students and employees by a wide range of learning and communication practitioners, including instructional designers, technical trainers, technical communication and professional communication specialists, technical writers, and of course primary school and college teachers of all levels (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The transformation of educational technology from a cottage industry to a profession is discussed in existing literature as a matter of growing concern (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

Educational software is a term used for any computer software which is made for an educational purpose (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). It encompasses different ranges from language learning software to classroom management software to reference software, and the like (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The purpose of all this software is to make some part of education more effective and efficient (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The use of computer hardware and software in education and training dates to the early 1940s, when American researchers developed flight simulators which used analog computers to generate simulated onboard instrument data (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). One such system was the type 19 synthetic radar trainer, built-in 1943. From these early attempts in the WWII era through the mid-1970s, educational software was directly tied to the hardware, on which it ran (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Pioneering educational computer

systems in this era included the PLATO system (1960), developed at the University of Illinois, and TICCIT (1969).

In 1963, IBM had established a partnership with Stanford University's Institute for Mathematical Studies in the Social Sciences (IMSSS), directed by Patrick Suppes, to develop the first comprehensive CAI elementary school curriculum which was implemented on a large scale in schools in both California and Mississippi (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). In 1967, Computer Curriculum Corporation (CCC, now Pearson Education Technologies) was formed to market to schools the materials developed through the IBM partnership (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Early terminals that ran educational systems cost over $10,000, putting them out of reach of most institutions (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Some programming languages from this period, p3), and LOGO (1967) can also be considered educational, as they were specifically targeted to students and novice computer users (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The PLATO IV system, released in 1972, supported many features which later became standard in educational software running on home computers (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Its features included bitmap graphics, primitive sound generation, and support for non-keyboard input devices, including the touchscreen (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

The arrival of the personal computer, with the Altair 8800 in 1975, changed the field of software in general, with specific implications for educational software (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Whereas users prior to 1975 were dependent upon the university or government-owned mainframe computers with timesharing, users after this shift could create and use software for computers in homes and schools, computers available for less than $2000 (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). By the early 1980s, the availability of personal computers, including the Apple II (1977), Commodore PET (1977),

Commodore VIC-20 (1980), and Commodore 64 (1982), allowed for the creation of companies and non-profits which specialized in educational software (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Brøderbund and The Learning Company are key companies from this period, and MECC, the Minnesota Educational Computing Consortium, a key non-profit software developer (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). These and other companies designed a range of titles for personal computers, with the bulk of the software initially developed for the Apple II (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014).

Courseware is a term that combines the words 'course' with 'software' (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). It was originally used to describe additional educational material intended as kits for teachers or trainers or as tutorials for students, usually packaged for use with a computer (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The term's meaning and usage has expanded and can refer to the entire course and any additional material when used in reference to an online or 'computer formatted' classroom (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Many companies are using the term to describe the entire "package" consisting of one 'class' or 'course' bundled together with the various lessons, tests, and other material needed (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The courseware itself can be in different formats (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). For example, some are only available online, such as Web pages, while others can be downloaded as PDF files or other types of document (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Many forms of educational technology are now covered by the term courseware. Most leading educational companies solicit or include courseware with their training packages (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

Some educational software is designed for use in school classrooms (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and

Lima, 2018; National Council for Special Education, 2013). Typically, such software may be projected onto a large whiteboard at the front of the class and run simultaneously on a network of desktop computers in a classroom (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). The most notable are SMART Boards that use SMART Notebook to interact with the board, which allows the use of pens to digitally draw on the board (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). This type of software is often called classroom management software (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). While teachers often choose to use educational software from other categories in their IT suites (e.g., reference works, children's software), a whole category of educational software has grown up specifically intended to assist classroom teaching (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Branding has been less strong in this category than in those oriented towards home users (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Software titles are often very specialized and produced by various manufacturers, including many established educational book publishers (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010).

With the impact of environmental damage and the need for institutions to become "paperless," more educational institutions are seeking alternative ways of assessment and testing, which has always traditionally been known to use up vast amount of paper (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Assessment software refers to software with a primary purpose of assessing and testing students in a virtual environment (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Assessment software allows students to complete tests and examinations using a computer, usually networked (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The software then scores each test transcript and outputs results for each student (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Assessment software is available in various delivery methods, the

most popular being self-hosted software, online software, and hand-held voting systems (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Proprietary software and open-source software systems are available. While technically falling into the Courseware category (see above), Skill evaluation lab is an example for Computer-based assessment software with PPA-2 (Plan, Prove, Assess) methodology to create and conduct computer-based online examination (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Moodle is an example of open-source software with an assessment component that is gaining popularity (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Other popular international assessment systems include Assessment Master, Google Classroom, Blackboard Learn, EvaluNet XT, and Eduroan (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019).

Many publishers of print dictionaries and encyclopedias have been involved in the production of educational reference software since the mid-1990s (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). They were joined in the reference software market by both startup companies and established software publishers, most notably Microsoft (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The first commercial reference software products were reformulations of existing content into CD-ROM editions, often supplemented with new multimedia content, including compressed video and sound (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). More recent products made use of internet technologies, to supplement CD-ROM products, then, more recently, to replace them entirely (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Wikipedia and its off spins (such as Wiktionary) marked a new departure in educational reference software (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Previously, encyclopedias and dictionaries had compiled their contents on the basis of invited and closed teams of specialists (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). The Wiki

concept has allowed for the development of collaborative reference works through open cooperation incorporating experts and non-experts (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010).

Some manufacturers regarded normal personal computers as an inappropriate platform for learning software for younger children and produced custom child-friendly pieces of hardware instead (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The hardware and software is generally combined into a single product, such as a child laptop-lookalike (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). The laptop keyboard for younger children follows an alphabetic order and the qwerty order for the older ones. The most well-known example are Leapfrog products (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). These include imaginatively designed hand-held consoles with a variety of pluggable educational game cartridges and book-like electronic devices into which a variety of electronic books can be loaded (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). These products are more portable than laptop computers, but have a much more limited range of purposes, concentrating on literacy (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

While mainstream operating systems are designed for general usages; they are also more or less customized for education only by the application sets added to them (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Hence, a variety of software manufacturers, especially Linux distributions, have sought to provide integrated platforms for specifically education (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Earlier educational software for the important corporate and tertiary education markets was designed to run on a single desktop computer, or an equivalent user device (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). In the years immediately following 2000, planners decided to switch to server-based applications with a high degree of standardization (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

This means that educational software runs primarily on servers which may be hundreds or thousands of miles from the actual user (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). The user only receives tiny pieces of a learning module or test, fed over the internet one by one. The server software decides on what learning material to distribute, collects results and displays progress to teaching staff (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Another way of expressing this change is to say that educational software morphed into an online educational service (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). US Governmental endorsements and approval systems ensured the rapid switch to the new way of managing and distributing learning material (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The next section will consider the long-term impact of a digital education.

3.4. LONG TERM IMPACT OF DIGITAL EDUCATION

Observers of the onset and propagation of educational technology are increasingly concerned about some unforeseen but important long-term effects it might have on society (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). This is particularly critical when considered in light of the short-term perspectives that are almost always referenced when commissioning new technologies (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Tutor-based education software is defined as software that mimics the teacher-student one on one dynamic of tutoring with software in place of a teacher (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Research was conducted to see if this type of software would be effective in improving students understanding of material (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). It concluded that there was a positive impact which decreased the amount of time students need to study for and relative gain of understanding (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Sometimes educational technologies have been used as an intervention in the context of another crisis, such as the COVID-19 pandemic (see Figure 3.4).

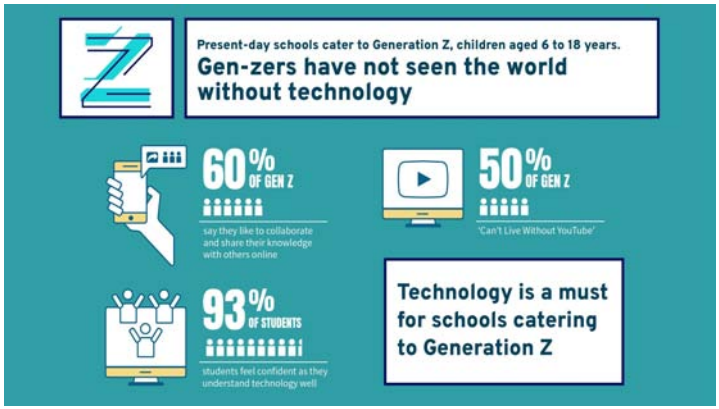

Figure 3.4: Long-term impact of COVID-19 on education.

Source: World Economic Forum.

One of the strong points in favor of educational technologies was the expectation that it would play a part in helping to include learners with disabilities (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). A study was conducted to see the effects of education software on children with mild disabilities (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The results were that the software was a positive impact assisting teaching these children social skills though team-based learning and discussion, videos, and games (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). There is a large market of educational software in use today (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). A team decided that they were to develop a system in which educational software should be evaluated as there is no current standard (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). It is called the Construction of the Comprehensive Evaluation of Electronic Learning Tools and Educational Software or CEELTES (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). The software to be evaluated is graded on a point scale in four categories. The first is the area of technical, technological, and user attributes (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

The second is the area of criteria evaluating the information, content, and operation of the software (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The third is the area of criteria evaluating the information in terms of educational use, learning, and recognition (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). The 4th is the area of criteria evaluating the psychological and pedagogical use of the software (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014).

In a university-level computer science course, learning logic is an essential part of the curriculum. There is a proposal on using two logistical education tools FOLST and LogicChess to understand First-Order Logic for university students to better understand the course material and the essentials of logistical design. Virtual and augmented reality (VR/AR) technologies are increasingly being used in the classroom as their technology becomes more powerful and affordable. ClassVR is a company that makes their own headsets and software specifically for using VR in the classroom. They have a vast amount of lesson plans that go along with their product. VR/AR are used as reinforcement of old concepts and as a way to introduce new ones as well. Many believe that there is great potential to make VR/AR commonplace to improve learning.

Artificial intelligence (AI) has become increasingly more advanced over the years (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Now it is being used in the classroom as teaching assistants that students can ask questions to and it will find and explain the answer (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). They are being used because it reduces the amount of time a teacher needs to spend on a specific question allow the teacher to explain the more complex material (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). One of the most popular examples is Brainly, a website that is used for asking educational questions (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Once a student asks a question, another student can answer it and Brainly will check its databases to make sure that the information is correct (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012;

Hanushek and Woessmann, 2010). A digital divide is an uneven distribution in the access to, use of, or impact of information and communications technologies (ICT) between any number of distinct groups, which can be defined based on social, geographical, or geopolitical criteria, or otherwise (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). The term digital divide was first coined by Lloyd Morrisett, when he was president of the Markle Foundation (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Traditionally considered to be a question of having or not having access, with a global mobile phone penetration of over 95%, it is becoming a relative inequality between those who have more and less bandwidth and more or fewer skills (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

Some of the key areas of concern include questions about who is the subject that connects (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). This may include individuals, organizations, enterprises, schools, hospitals, countries, and similar entities (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Researchers are also concerned about which characteristics or attributes are distinguished to describe the divide (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). These may include income, education, age, geographic location, motivation, reason not to use, and the like (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). It is pertinent to consider how sophisticated the usage of educational technology is (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). This may include mere access, retrieval, interactivity, intensive, and extensive in usage, and innovative contributions (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Another question relates to the entities of objects that the subject connects to (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). This may include fixed or mobile, Internet or telephone, digital TV, and broadband (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

All these factors can be scenes and drivers of inequalities which educational technology has not yet comprehensively addressed (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This chapter will close with a review of the structural and infrastructural mandates that are associated with educational technology.

3.5. STRUCTURES AND INFRASTRUCTURE OF EDUCATIONAL TECHNOLOGY

Having the right structures and infrastructure is critical for effective access to educational technologies (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The infrastructure by which individuals, households, businesses, and communities connect to the Internet address the physical mediums that people use to connect to the Internet (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Examples include desktop computers, laptops, basic mobile phones or smartphones, iPods or other MP3 players, gaming consoles such as Xbox or PlayStation, electronic book readers, and tablets such as iPads (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). The digital divide measured in terms of bandwidth is not closing, but fluctuating up and down (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Gini coefficients for telecommunication capacity (in Kbits) among individuals worldwide (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Despite some of these potential challenges, technology is seen as a key to sustainable development (see Figure 3.5).

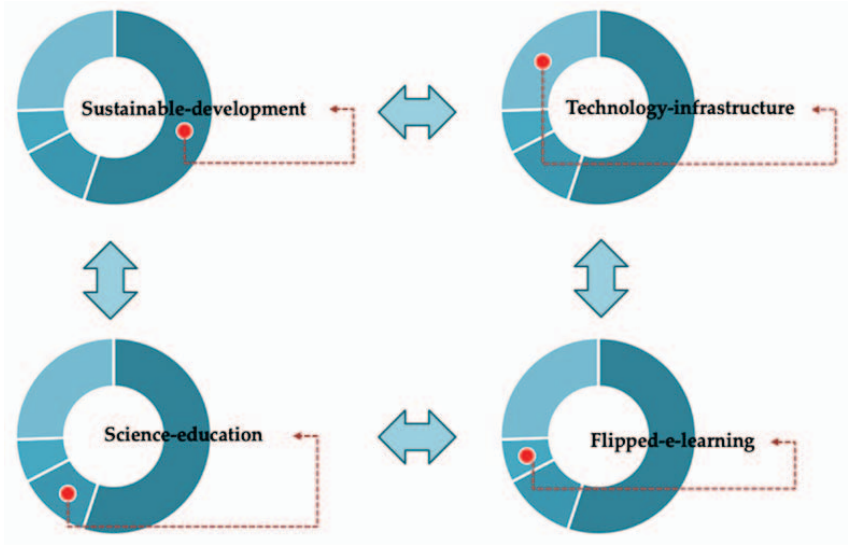

Figure 3.5: Education for sustainable development.

Source: MDPI.

Traditionally, the nature of the divide has been measured in terms of the existing numbers of subscriptions and digital devices (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Given the increasing number of such devices, some have concluded that the digital divide among individuals has increasingly been closing as the result of a natural and almost automatic process (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Others point to persistent lower levels of connectivity among women, racial, and ethnic minorities, people with lower incomes, rural residents, and less educated people as evidence that addressing inequalities in access to and use of the medium will require much more than the passing of time (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Recent studies have measured the digital divide not in terms of technological devices, but in terms of the existing bandwidth per individual in Kbits per capita (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

The digital divide in Kbits is not monotonically decreasing but re-opens up with each new innovation (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and

Lawson, 2001). For example, the massive diffusion of narrow-band internet and mobile phones during the late 1990s" increased digital inequality, as well as the initial introduction of broadband DSL and cable modems during 2003–2004 increased levels of inequality (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). This is because a new kind of connectivity is never introduced instantaneously and uniformly to society as a whole at once, but diffuses slowly through social networks (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

During the mid-2000s, communication capacity was more unequally distributed than during the late 1980s, when only fixed-line phones existed (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The most recent increase in digital equality stems from the massive diffusion of the latest digital innovations (i.e., fixed and mobile broadband infrastructures), including 3G and fiber optics FTTH (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Measurement methodologies of the digital divide (such as the Integrated Iterative Approach General Framework or Integrated Contextual Iterative Approach-ICI) and the digital divide modeling theory under measurement model DDG (Digital Divide Gap) are used (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). These help to analyze the gap existing between developed and developing countries (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). The same methodology is used to assess the gap among the 27 member-states of the European Union (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007).

Due to the rapidly declining price of connectivity and hardware, skills deficits have eclipsed barriers of access as the primary contributor to the gender digital divide (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Studies show that women are less likely to know how to leverage devices and internet access to their full potential, even when they do use digital technologies (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). In rural India, for example, a study found that the majority of women who owned mobile phones only knew how to answer

calls (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). They could not dial numbers or read messages without assistance from their husbands, due to a lack of literacy and numeracy skills (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

Gender is an important dividing line when using educational and non-educational technologies (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). For example, research conducted across 25 countries found that adolescent boys with mobile phones used them for a wider range of activities, from playing games to accessing financial services online (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). By way of contrast, adolescent girls tended to use just the basic functionalities such as making phone calls and using the calculator (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Similar trends can be seen even in areas where internet access is near-universal (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). A survey of women in nine cities around the world revealed that although 97% of women were using social media, only 48% of them were expanding their networks (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Other research found that only 21% of internet-connected women had searched online for information related to health, legal rights, or transport (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). In some cities, less than one-quarter of connected women had used the internet to look for a job.

SUMMARY

This chapter has highlighted some points of criticism for educational technology. First of all, this technology tends to create, emphasize, and sustain social divisions. The modalities of its operation such as teaching and assessment have also been critiqued for being inaccurate and often inappropriate to the learning needs of the community. Many of the developing communities that arguably need this technology most do not have the structures and infrastructure that is necessary to sustain them. As a

consequence, educational technology has turned into a symbol of what some have and what others do not. In the next chapter, we further explore the social constructions of a digital life and how they impact on the community.

Chapter

4 Social Constructions of Digital Life

CONTENTS

The rise in digital lives has led to the development of social constructions around it. This chapter issues such disability, gender, race, and age in terms of how they impact on access to educational technology. It also examines how social capital and social exclusion are impacted by the digitization of the education sector. Finally, the chapter examines the basic service requirements for educational technologies. By the end of this chapter, the reader will have a broad view of how society conceives and responds to technology in education.

4.1. RACE, DISABILITY, GENDER, AND EDUCATIONAL TECHNOLOGY

There are certain societal gaps and divisions which are either intensified or moderated by the presence of educational technologies (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). The racial gap is a primary example in both developing and developed countries (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Although many groups in society are affected by a lack of access to computers or the internet, communities of color are specifically observed to be negatively affected by the digital divide (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). This is evident when it comes to observing home-internet access among different races and ethnicities (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Sometimes there can be an intersectionality of two exclusionary factors such as race and disabilities (see Figure 4.1).

About 81% of Whites and 83% of Asians have home internet access, compared to 70% of Hispanics, 68% of Blacks, 72% of American Indian/Alaska Natives, and 68% of Native Hawaiian/Pacific Islanders (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Although income is a factor in home-internet access disparities, there are still racial and ethnic inequalities that are present among those within lower-income groups (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). For example, 58% of low-income Whites are reported to have home-internet access in comparison to 51% of Hispanics and 50% of Blacks (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and

Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Some researchers have concluded that structural barriers and discrimination that perpetuates bias against people of different races and ethnicities contribute to having an impact on the digital divide (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Hence, those who do not have internet access still have a high demand for it, and reduction in the price of home-internet access would allow for an increase in equitable participation and improve internet adoption by marginalized groups (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

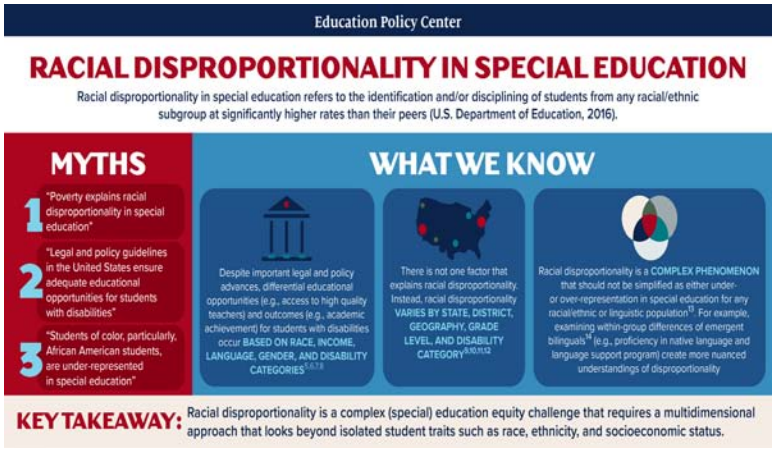

Figure 4.1: Race and special education.

Source: University of Arizona.

Digital censorship and algorithmic bias are observed to be present in the racial divide (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Hate-speech rules as well as hate speech algorithms online platforms such as Facebook have favored white males and those belonging to elite groups in society over marginalized groups in society, such as women and people of color (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). In a collection of internal documents that were collected in a project conducted by ProPublica, Facebook's guidelines in regards to distinguishing hate speech and recognizing protected groups revealed slides that identified three groups, each one containing either female drivers, black children, or white men (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis

and Deponio, 2014; Drisko, 2014; Durodie, 2016). When the question of which subset group is protected is presented, the correct answer was white men (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Minority group language is negatively impacted by automated tools of hate detection due to human bias that ultimately decides what is considered hate speech and what is not (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

Inequities in access to information technologies are present among individuals living with a disability in comparison to those who are not living with a disability (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). According to The Pew Research Center, 54% of households with a person who has a disability have home internet access compared to 81% of households that have home internet access and do not have a person who has a disability (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). The type of disability an individual has can prevent one from interacting with computer screens and smartphone screens, such as having a quadriplegia disability or having a disability in the hands (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). However, there is still a lack of access to technology and home internet access among those who have a cognitive and auditory disability as well (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). There is a concern of whether or not the increase in the use of information technologies will increase equality through offering opportunities for individuals living with disabilities or whether it will only add to the present inequalities and lead to individuals living with disabilities being left behind in society (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Issues such as the perception of disabilities in society, Federal, and state government policy, corporate policy, mainstream computing technologies, and real-time online communication have been found to contribute to the impact of the digital divide on individuals with disabilities (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). A paper published by J. Cooper from Princeton University points out that learning technology is

designed to be receptive to men instead of women (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The reasoning for this is that most software engineers and programmers are men, and they communicate their learning software in a way that would match the reception of their recipient (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The association of computers in education is normally correlated with the male gender, and this has an impact on the education of computers and technology among women (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). However, it is important to acknowledge that there are plenty of learning software that are designed to help women and girls learn technology (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

Overall, the study presents the problem of various perspectives in society that are a result of gendered socialization patterns that believe that computers are a part of the male experience since computers have traditionally presented as a toy for boys when they are children (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This divide is followed as children grow older and young girls are not encouraged as much to pursue degrees in IT and computer science (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In 1990, the percentage of women in computing jobs was 36%, however in 2016, this number had fallen to 25% (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). This can be seen in the underrepresentation of women in IT hubs such as Silicon Valley (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

There has also been the presence of algorithmic bias that has been shown in machine learning algorithms that are implemented by major companies (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). In 2015, Amazon had to abandon a recruiting algorithm that showed a difference between ratings that candidates received for software developer jobs as well as other technical jobs (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). As a result, it was revealed that Amazon's machine algorithm

was biased against women and favored male resumes over female resumes (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This was due to the fact that Amazon's computer models were trained to vet patterns in resumes over a 10-year period (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). During this 10-year period, the majority of the resumes belong to male individuals, which is a reflection of male dominance across the tech industry (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015).

A number of states, including some that have introduced new laws since 2010, notably censor voices from and content related to the LGBT (Lesbian, Gay, Bisexual, and Transgender) community, posing serious consequences to access to information about sexual orientation and gender identity (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Digital platforms play a powerful role in limiting access to certain content, such as YouTube's 2017 decision to classify non-explicit videos with LGBT themes as 'restricted,' a classification designed to filter out 'potentially inappropriate content' (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The internet provides information that can create a safe space for marginalized groups such as the LGBT community to connect with others and engage in honest dialogs and conversations that are affecting their communities (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). It can also be viewed as an agent of change for the LGBT community and provide a means of engaging in social justice (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015).

The internet can allow for LGBT individuals who may be living in rural areas or in areas where they are isolated to gain access to information that are not within their rural system as well as gaining information from other LGBT individuals (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). This includes information such as healthcare, partners, and news (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). GayHealth provides online medical and health information, and Gay and Lesbians Alliance Against Defamation contains online publications and news that focus on human

rights campaigns, and issues focused on LGBT issues (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The internet also allows LGBT individuals to maintain anonymity (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Lack of access to the internet can hinder these things, due to lack of broadband access in remote rural areas (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). LGBT Tech has emphasized launching newer technologies with 5G technology in order to help close the digital divide that can cause members of the LGBT community to lose access to reliable and fast technology that can provide information on healthcare, economic opportunities, and safe communities (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). The next section considers the role of age in the type of social exclusion that is associated with modern technologies.

4.2. AGE AND SOCIAL EXCLUSION THROUGH TECHNOLOGIES

Older adults, those ages 60 and up, face various barriers that contribute to their lack of access to information and communication technologies or ICTs (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Many adults are "digital immigrants" who have not had a lifelong exposure to digital media and have had to adapt to incorporating it into their lives (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). A study in 2005 found that only 26% of people aged 65 and over were Internet users, compared to 67% in the 50–64 age group and 80% in the 30–49-year age group (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). This "gray divide" can be due to factors such as concern over security, motivation, and self-efficacy, decline of memory or spatial orientation, cost, or lack of support (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The aforementioned variables of race, disability, gender, and sexual orientation also add to the barriers for older adults (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore,

2014). In Figure 4.2, we see the possibility of gender and age leading to intersectionality in terms of social exclusion (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). This is a gap which online technology has not yet fully bridged (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

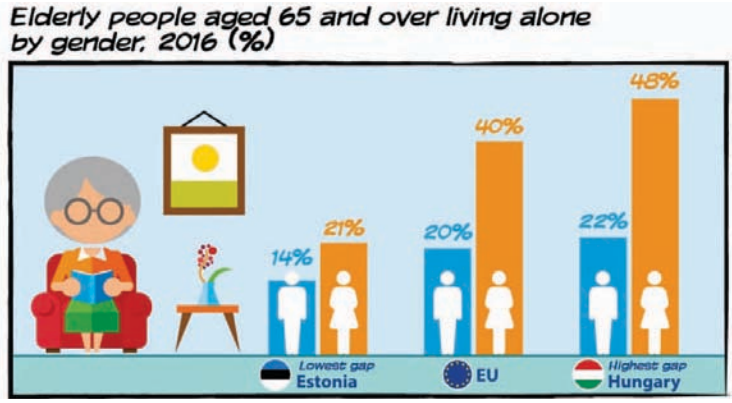

Figure 4.2: Social isolation among the elderly by gender.

Source: AGE Platform Europe.

Many older adults may have physical or mental disabilities that render them homebound and financially insecure (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). They may be unable to afford internet access or lack transportation to use computers in public spaces, the benefits of which would be enhancing their health and reducing their social isolation and depression (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Homebound older adults would benefit from internet use by using it to access health information, use telehealth resources, shop, and bank online, and stay connected with friends or family using email or social networks (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

Those in more privileged socio-economic positions and with a higher level of education are more likely to have internet access than those older adults living in poverty (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman,

and Zhou, 2004). Lack of access to the internet inhibits "capital-enhancing activities" such as accessing government assistance, job opportunities, or investments (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The results of the U.S. Federal Communication Commission's 2009 National Consumer Broadband Service Capability Survey show that older women are less likely to use the internet, especially for capital enhancing activities, than their male counterparts (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

The Facebook divide, a concept derived from the "digital divide," is the phenomenon with regard to access to, use of, or impact of Facebook on individual society and among societies (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). It is suggested at the International Conference on Management Practices for the New Economy (ICMAPRANE-17) on February 10–11, 2017 (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Additional concepts of Facebook Native and Facebook Immigrants are suggested at the conference (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The Facebook Divide, Facebook native, Facebook immigrants, and Facebook left-behind are concepts for social and business management research (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Facebook Immigrants are utilizing Facebook for their accumulation of both bonding and bridging social capital (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). These Facebook natives, Facebook Immigrants, and Facebook left-behind induced the situation of Facebook inequality (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). In February 2018, the Facebook Divide Index was introduced at the ICMAPRANE conference in Noida, India, to illustrate the Facebook Divide phenomenon (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010).

An individual must be able to connect in order to achieve enhancement of social and cultural capital as well as achieve mass economic gains in productivity (Casey and Evans, 2011; Cercone, 2008; Chang and Chen,

2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Therefore, access is a necessary condition for overcoming the digital divide (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Access to ICT meets significant challenges that stem from income restrictions (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). The borderline between ICT as a necessity good and ICT as a luxury good is roughly around the "magical number" of US$10 per person per month, or US$120 per year (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This means that people consider ICT expenditure of US$120 per year as a basic necessity (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Since more than 40% of the world population lives on less than US$2 per day, and around 20% live on less than US$1 per day or less than US$365 per year, these income segments would have to spend one-third of their income on ICT which comes to 120/365 or 33% (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). The global average of ICT spending is at a mere 3% of income (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Potential solutions include driving down the costs of ICT, which includes low-cost technologies and shared access through Telecenters (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006).

Furthermore, even though individuals might be capable of accessing the internet, many are thwarted by barriers to entry, such as a lack of means to infrastructure or the inability to comprehend the information that the internet provides (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Lack of adequate infrastructure and lack of knowledge are two major obstacles that impede mass connectivity (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). These barriers limit individuals' capabilities in what they can do and what they can achieve in accessing technology (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Some individuals can connect, but they do not have the knowledge to use what information ICTs and Internet technologies provide them (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and

Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). This leads to a focus on capabilities and skills, as well as awareness to move from mere access to the effective usage of ICT (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). In the next section, we consider how online technologies harness or even hinder social capital networks.

4.3. SOCIAL CAPITAL NETWORKS AND TECHNOLOGY

Once an individual is connected, Internet connectivity and ICTs can enhance his or her future social and cultural capital (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Social capital is acquired through repeated interactions with other individuals or groups of individuals (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

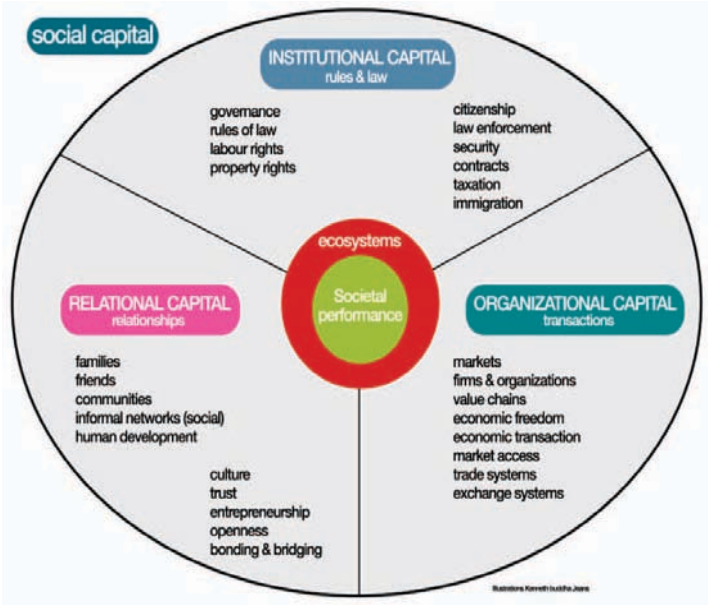

Figure 4.3: Various social capital networks.

Source: Pinterest.

Connecting to the internet creates another set of means by which to achieve repeated interactions (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). ICTs and Internet connectivity enable repeated interactions through access to social networks, chat rooms, and gaming sites (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Once an individual has access to connectivity, obtains infrastructure by which to connect, and can understand and use the information that ICTs and connectivity provide, that individual is capable of becoming a "digital citizen" (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Digital technology can reach the various forms and sources of social capital networks (see Figure 4.3).

In the United States, the research provided by Sungard Availability Services notes a direct correlation between a company's access to technological advancements and its overall success in bolstering the economy (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). The study, which includes over 2,000 IT executives and staff officers, indicates that 69% of employees feel they do not have access to sufficient technology in order to make their jobs easier (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). At the same time, 63% of them believe the lack of technological mechanisms hinders their ability to develop new work skills (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). The additional analysis provides more evidence to show how the digital divide also affects the economy in places all over the world (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). A BCG report suggests that in countries like Sweden, Switzerland, and the U.K., the digital connection among communities is made easier, allowing for their populations to obtain a much larger share of the economies via digital business (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). In fact, in these places, populations hold shares approximately 2.5% points higher (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). During a meeting with the United Nations, a Bangladesh representative expressed his concern that poor and undeveloped countries would be left behind due to a

lack of funds to bridge the digital gap (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

The digital divide also impacts children's ability to learn and grow in low-income school districts (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Without Internet access, students are unable to cultivate necessary tech skills in order to understand today's dynamic economy (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). The Federal Communication Commission's Broadband Task Force created a report showing that about 70% of teachers give students homework that demand access to broadband (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Furthermore, approximately 65% of young scholars used the internet at home to complete assignments as well as connect with teachers and other students via discussion boards and shared files (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). A recent study indicates that practically 50% of students say that they are unable to finish their homework due to an inability to either connect to the internet or, in some cases, find a computer (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Hence, about 42% of students say they received a lower grade because of this disadvantage (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Finally, according to research conducted by the Center for American Progress, if the United States were able to close the educational achievement gaps between native-born white children and black and Hispanic children, the U.S. economy would be 5.8% (or nearly $2.3 trillion) larger in 2050 (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

In a reverse of this idea, well-off families, especially the tech-savvy parents in Silicon Valley, carefully limit their own children's screen time (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The children of wealthy families attend play-based preschool programs that emphasize social interaction instead of time spent in front of computers or other digital devices, and they pay to send their children to schools that limit

screen time (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). American families that cannot afford high-quality childcare options are more likely to use tablet computers filled with apps for children as a cheap replacement for a babysitter, and their government-run schools encourage screen time during school (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Furthermore, according to the 2012 Pew Report "Digital Differences," a mere 62% of households who make less than $30,000 a year use the internet, while 90% of those making between $50,000 and $75,000 had access (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

Studies also show that only 51% of Hispanics and 49% of African Americans have high-speed internet at home (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). This is compared to the 66% of Caucasians that too have high-speed internet in their households (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Overall, 10% of all Americans do not have access to high-speed internet, an equivalent of almost 34 million people (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Supplemented reports from the Guardian demonstrate the global effects of limiting technological developments in poorer nations, rather than simply the effects in the United States (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Their study shows that rapid digital expansion excludes those who find themselves in the lower class (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Around 60% of the world's population, almost 4 billion people, have no access to the internet and are thus left worse off (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016).

Since gender, age, racial, income, and educational digital divides have lessened compared to the past, some researchers suggest that the digital divide is shifting from a gap in access and connectivity to ICTs to a knowledge divide (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). A knowledge divide concerning technology presents the possibility that the gap

has moved beyond the access and having the resources to connect to ICTs to interpreting and understanding the information presented once connected (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The second-level digital divide, also referred to as the production gap, describes the gap that separates the consumers of content on the internet from the producers of content (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). As the technological digital divide is decreasing between those with access to the internet and those without, the meaning of the term digital divide is evolving (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010).

Previously, digital divide research has focused on accessibility to the Internet and Internet consumption (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). However, with more and more of the population gaining access to the internet, researchers are examining how people use the internet to create content and what impact socioeconomics are having on user behavior (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). New applications have made it possible for anyone with a computer and an Internet connection to be a creator of content, yet the majority of user-generated content available widely on the internet, like public blogs, is created by a small portion of the Internet-using population (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Web 2.0 technologies like Facebook, YouTube, Twitter, and Blogs enable users to participate online and create content without having to understand how the technology actually works, leading to an ever-increasing digital divide between those who have the skills and understanding to interact more fully with the technology and those who are passive consumers of it (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Many are only nominal content creators through the use of Web 2.0, posting photos and status updates on Facebook, but not truly interacting with the technology (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016).

Some of the reasons for this production gap include material factors like the type of Internet connection one has and the frequency of access to the Internet (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye,

Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). The more frequently a person has access to the internet and the faster the connection, the more opportunities they have to gain the technology skills and the more time they have to be creative (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Other reasons include cultural factors often associated with class and socioeconomic status. Users of lower socioeconomic status are less likely to participate in content creation due to disadvantages in education and lack of the necessary free time for the work involved in blog or web site creation and maintenance (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Additionally, there is evidence to support the existence of the second-level digital divide at the K-12 level based on how educators' use technology for instruction (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Schools' economic factors have been found to explain variation in how teachers use technology to promote higher-order thinking skills (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The next section considers the role of global hegemonies in educational technologies.

4.4. GLOBAL HEGEMONIES IN EDUCATIONAL TECHNOLOGY

The global digital divide describes global disparities, primarily between developed and developing countries, in regards to access to computing and information resources such as the internet and the opportunities derived from such access (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). As with a smaller unit of analysis, this gap describes an inequality that exists, referencing a global scale (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The internet is expanding very quickly (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). However, not all countries (especially developing countries) can keep up with the constant changes (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). The term "digital divide" does not necessarily mean that someone does not have technology

(Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). It could also mean that there is simply a difference in technology (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). These differences can refer to, for example, high-quality computers, fast internet, technical assistance, or telephone services (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). The difference between all of these is also considered a gap (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Figure 4.4 is a visual representation of global hegemonies in terms of providing access to online services.

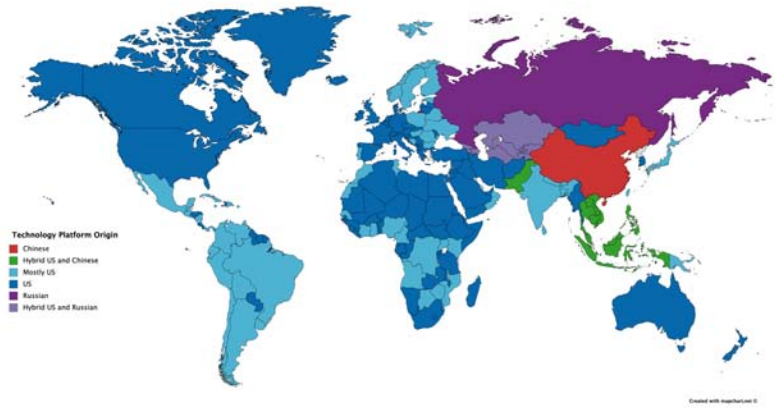

Figure 4.4: Global hegemonies in educational technology.

Source: Medium.

There is a large inequality worldwide in terms of the distribution of installed telecommunication bandwidth (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). In 2014 only three countries (China, US, Japan) host 50% of the globally installed bandwidth potential (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This concentration is not new, as historically only 10 countries have hosted 70–75% of the global telecommunication capacity (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The

U.S. lost its global leadership in terms of installed bandwidth in 2011, being replaced by China, which hosts more than twice as much national bandwidth potential in 2014, or 29% versus 13% of the global total (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). The global digital divide is a special case of the digital divide. In this case, the focus is set on the fact that internet has developed unevenly throughout the world (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). This has had the effect of causing some countries to fall behind in technology, education, labor, democracy, and tourism (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

The concept of the digital divide was originally popularized regarding the disparity in Internet access between rural and urban areas of the United States of America (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Indeed, the global digital divide mirrors this disparity on an international scale (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). The global digital divide also contributes to the inequality of access to goods and services available through technology (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Computers and the Internet provide users with improved education, which can lead to higher wages (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). The people living in nations with limited access are therefore disadvantaged (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). This global divide is often characterized as falling along what is sometimes called the North-South divide of "northern" wealthier nations and "southern" poorer ones (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Some people argue that necessities need to be considered before achieving digital inclusion, such as an ample food supply and quality health care (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Minimizing the global digital divide requires considering and addressing the following types of access: physical, financial, and sociodemographic categories (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler,

2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). This chapter will close with a section on the basic requirements and services that support educational technologies.

4.5. BASIC REQUIREMENTS AND SERVICES IN EDUCATIONAL TECHNOLOGIES

There are certain services that are necessary for the full adoption of educational technologies (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). One of the providers of that service is branded as "Free Basics" (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). This is a partnership between social networking services company Facebook and six companies including Samsung, Ericsson, MediaTek, Opera Software, Nokia, and Qualcomm (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). These are companies that plans to bring affordable access to selected Internet services to less developed countries by increasing efficiency (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). They will also help in facilitating the development of new business models around the provision of Internet access (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014).

In the whitepaper released by Facebook's founder and CEO Mark Zuckerberg, connectivity is asserted as a "human right," and Internet.org is created to improve Internet access for people around the world (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). As demonstrated in Figure 4.5, educational technology has the ability to influence many aspects of personal and community lives. All this depends on the ways in which this technology is distributed and used (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

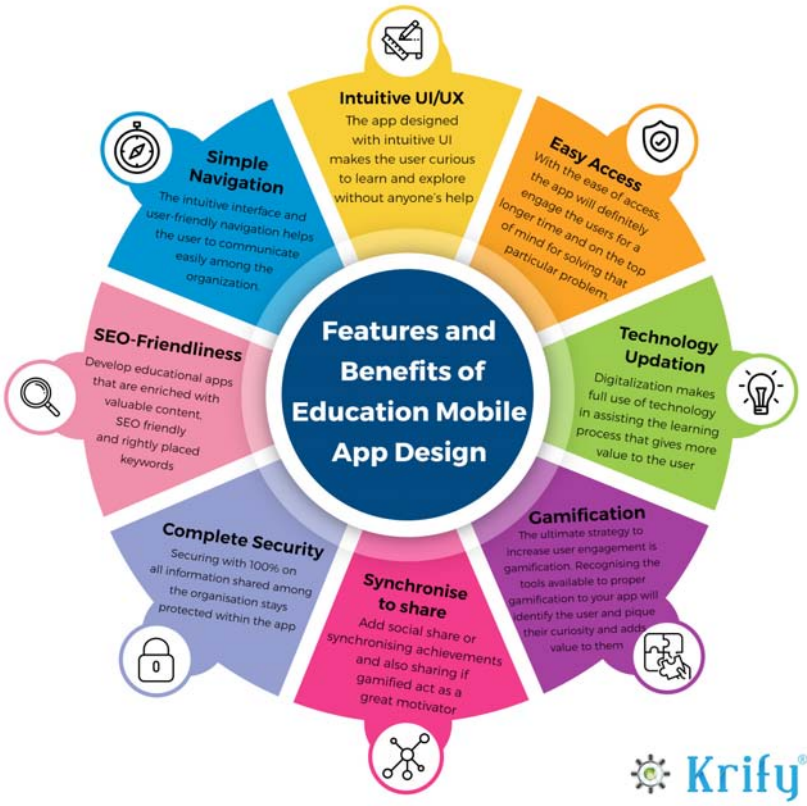

Figure 4.5: Impact of mobile technology on education.

Source: Krify.

Free Basics provides a range of people and communities with access to useful services on their mobile phones in markets where internet access may be less affordable (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). These websites are available for free without data charges (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). They typically include content about news, employment, health, education, and local information (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). By introducing people to the benefits of the internet through these websites, the creators this initiative hope to bring more people online and consequently help them improve their

lives (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). However, Free Basics is also accused of violating net neutrality for limiting access to handpicked services (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Despite a wide deployment in numerous countries, it has been met with heavy resistance notably in India where the Telecom Regulatory Authority of India eventually banned it in 2016 (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014).

Several projects to bring internet to the entire world with a satellite constellation have been devised in the last decade, one of these being Starlink by Elon Musk's company SpaceX (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Unlike Free Basics, it would provide people with a full internet access and would not be limited to a few selected services (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). In the same week Starlink was announced, serial-entrepreneur Richard Branson announced his own project OneWeb, a similar constellation with approximately 700 satellites that was already procured communication frequency licenses for their broadcast spectrum and could possibly be operational on 2020 (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). The biggest hurdle to these projects is the astronomical, financial, and logistical cost of launching so many satellites (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

One laptop per child (OLPC) is another attempt to narrow the digital divide (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). This organization, founded in 2005, provides inexpensively produced "XO" laptops (dubbed the "$100 laptop," though actual production costs vary) to children residing in poor and isolated regions within developing countries (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Each laptop belongs to an individual child and provides a gateway to digital learning and Internet access (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The XO laptops are designed to withstand more abuse than higher-end machines, and they contain features in context

to the unique conditions that remote villages present (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Each laptop is constructed to use as little power as possible, have a sunlight-readable screen, and is capable of automatically networking with other XO laptops in order to access the Internet (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Hence, as many as 500 machines can share a single point of access (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014).

SUMMARY

This fourth chapter has highlighted some of the social constructions that have enabled humanity to understand and work with modern technology. However, we have also seen that there are societal problems that are either created or made worse by the addition of modern technology. Some of these include discrimination against minority or vulnerable groups, unequal access, and disruptions of the social order. This chapter has explored some altruistic attempts to spread computer technology to the poorest parts of the world. These efforts have achieved mixed results. The next chapter places educational technology within the broader theories of e-learning.

Chapter

5

Theory of E-Learning

CONTENTS

Although relatively 'young,' there is a growing body of theory that is dedicated to e-Learning. This chapter explores this theory in terms of principles of multimedia instructional design and the adoption of earlier models of learning. We also consider the case of online learning within the highest institutions of learning. The chapter will close with a review of the classic massive open online course. By the end of this chapter, the reader should have a broad view of how the theory of e-Learning is sourced and rationalized.

5.1. PRINCIPLES OF MULTIMEDIA INSTRUCTIONAL DESIGN

E-learning theory describes the cognitive science principles of effective multimedia learning using electronic educational technology (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Beginning with cognitive load theory as their motivating scientific premise, researchers such as Richard E. Mayer, John Sweller, and Roxana Moreno established within the scientific literature a set of multimedia instructional design principles that promote effective learning (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Many of these principles have been "field-tested" in everyday learning settings and found to be effective there as well (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

The majority of this body of research has been performed using university students given relatively short lessons on technical concepts with which they held low prior knowledge (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). However, David Roberts has tested the method with students in nine social science disciplines including sociology, politics, and business studies (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). His longitudinal research program over 3 years established a clear improvement in levels of student engagement and in the development of active learning principles among students exposed to a combination of images and text, over students exposed only to text (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). In Figure 5.1, we see examples of Mayer's principles.

Figure 5.1: Principles of multimedia instructional design.

Source: Mayer via Pinterest.

A number of other studies have shown these principles to be effective with learners of other ages and with non-technical learning content (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Research using learners who have greater prior knowledge in the lesson material sometimes finds results that contradict these design principles (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). This has led some researchers to put forward the "expertise effect" as an instructional design principle unto itself (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The underlying theoretical premise, cognitive load theory, describes the amount of mental effort that is related to performing a task as falling into one of three categories: germane, intrinsic, and extraneous (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Germane cognitive load refers to the mental effort required to process the task's information, make sense of it, and access and store it in long-term memory (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). A case in point is seeing a math problem, identifying the values and operations involved, and understanding that your task is to solve the math problem. Intrinsic cognitive load refers to the mental effort required to perform the task itself, a case in point being actually solving

the math problem (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Extraneous cognitive load refers to the mental effort imposed by the way that the task is delivered, which may or may not be efficient (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). A case in point is finding the math problem you are supposed to solve on a page that also contains advertisements for books about math.

The multimedia instructional design principles identified by Mayer, Sweller, Moreno, and their colleagues are largely focused on minimizing extraneous cognitive load and managing intrinsic and germane loads at levels that are appropriate for the learner (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Examples of these principles in practice include reducing extraneous load by eliminating visual and auditory effects and elements that are not central to the lesson, such as seductive details (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). This is known as the coherence principle. A second intervention involves reducing germane load by delivering verbal information through audio presentation (narration) while delivering relevant visual information through static images or animations (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). This is known as the modality principle. The third intervention involves controlling intrinsic load by breaking the lesson into smaller segments and giving learners control over the pace at which they move forward through the lesson material (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). This is what is known as the segmenting principle.

Cognitive load theory (and by extension many of the multimedia instructional design principles) is based in part on a model of working memory by Alan Baddeley and Graham Hitch (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). These are researchers who proposed that working memory has two largely independent, limited capacity sub-components that tend to work in parallel (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). In this case, there is one that visual and one which verbal or acoustic (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). This

gave rise to dual-coding theory, first proposed by Allan Paivio and later applied to multimedia learning by Richard Mayer (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). According to Mayer. It posits that separate channels of working memory help to process auditory and visual information during any lesson (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Consequently, a learner can use more cognitive processing capacities to study materials that combine auditory verbal information with visual graphical information than to process materials that combine printed (visual) text with visual graphical information (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). In other words, the multi-modal materials reduce the cognitive load imposed on working memory (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

In a series of studies, Mayer, and his colleagues tested Paivio's dual-coding theory, with multimedia lesson materials (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). They repeatedly found that students given multimedia with animation and narration consistently did better on transfer questions than those who learn from animation and text-based materials (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). That is, they were significantly better when it came to applying what they had learned after receiving multimedia rather than mono-media (visual only) instruction (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). These results were then later confirmed by other groups of researchers (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). The initial studies of multimedia learning were limited to logical scientific processes that centered on cause-and-effect systems like automobile braking systems, how a bicycle pump works or cloud formation (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). However, subsequent investigations found that the modality effect extended to other areas of learning (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). In the next section, we explore some empirically established theories of e-Learning.

5.2. EMPIRICALLY ESTABLISHED THEORIES OF E-LEARNING

There are a number of empirically established principles that are often referenced when designing an e-learning environment (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). A case in point is the multimedia principle in which deeper learning is observed when words and relevant graphics are both presented than when words are presented alone (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). This is also called the multimedia effect. Hence, the three most common elements in multimedia presentations are relevant graphics, audio narration, and explanatory text (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Combining any two of these three elements works better than using just one or all three (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014).

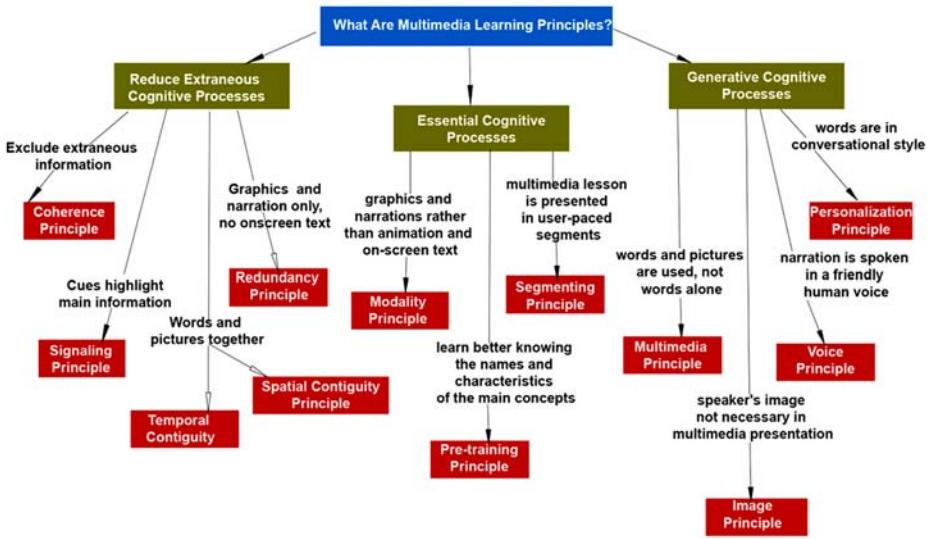

Figure 5.2: Multimedia learning principles.

Source: Tuba Oney via WordPress.

Figure 5.2 summarizes the multimedia learning principles that are often deployed when working with educational technologies (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009).

Another key anchor of e-Learning is the modality principle in which deeper learning occurs when graphics are explained by audio narration instead of onscreen text (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Exceptions have been observed when learners are familiar with the content, are not native speakers of the narration language, or when only printed words appear on the screen (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). For the most part, audio narration leads to better learning than the same words presented as text on the screen (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). This is especially true for walking someone through graphics on the screen, and when the material to be learned is complex or the terminology being used is already understood by the student (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). This otherwise known as "pre-training" for purposes of e-Learning. One exception to this is when the learner will be using the information as a reference and will need to look back to it again and again (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004).

The coherence principle posits that tutors should avoid certain aspects including graphics, music, narration, and other content that does not support the learning (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). This helps focus the learner on the content they need to learn, and minimizes cognitive load imposed on memory by irrelevant and possibly distracting content (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). The less learners know about the lesson content, the easier it is for them to get distracted by anything shown that is not directly relevant to the lesson (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). For learners with greater prior knowledge, some motivational imagery may still increase their interest and learning effectiveness (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

According to the contiguity principle, tutors should keep related pieces of information together (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Deeper learning occurs when relevant text (for example, a label) is placed close to graphics, when spoken words and graphics are presented at the same time, and when feedback is presented next to the answer given by the learner (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Alternatively, the segmenting principle suggests that deeper learning occurs when content is broken into small chunks (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Hence, teachers following this principle break down long lessons into several shorter lessons (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). They also break down long text passages into multiple shorter ones (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The signaling principle suggests that the use of visual, auditory, or temporal cues to draw attention to critical elements of the lesson (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Common techniques include arrows, circles, highlighting or bolding text, and pausing or vocal emphasis in narration (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Ending lesson segments after the critical information has been given may also serve as a signaling cue (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998).

The learner control principle suggests that deeper learning occurs when learners can control the rate at which they move forward through segmented content (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Learners tend to do best when the narration stops after a short, meaningful segment of content is given and the learner has to click a “continue” button in order to start the next segment (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Some research suggests not overwhelming the learner with too many control options, however (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Giving just pause and play buttons

may work better than giving pause, play, fast forward, reverse buttons (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Moreover, high prior-knowledge learners may learn better when the lesson moves forward automatically, but they have a pause button that allows them to stop when they choose to do so (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

According to the personalization principle, deeper learning in multimedia lessons occur when learners experience a stronger social presence, as when a conversational script or learning agents are used (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The effect is best seen when the tone of voice is casual, informal, and in a 1st person or 2nd person voice (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Moreover, research suggests that using a polite tone of voice leads to deeper learning for low prior knowledge learners than does a less polite, more directive tone of voice (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). However, it may impair deeper learning in high prior knowledge learners (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Finally, adding pedagogical agents (computer characters) can help if used to reinforce important content (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). For example, have the character narrate the lesson, point out critical features in on-screen graphics, or visually demonstrate concepts to the learner (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995).

The pre-training principle suggests that deeper learning occurs when lessons present key concepts or vocabulary prior to presenting the processes or procedures related to those concepts (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). According to Mayer, Mathias, and Wetzel; before presenting a multimedia explanation, make sure learners visually recognize each major component, can name each component and can describe the major state changes of each component (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell,

2006). In short, teachers should make sure that learners build component models before presenting a cause-and-effect explanation of how a system works (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). However, others have noted that including pre-training content appears to be more important for low prior knowledge learners than for high prior knowledge learners (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014).

The redundancy principle posits that deeper learning occurs when lesson graphics are explained by audio narration alone rather than audio narration and on-screen text (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This effect is stronger when the lesson is fast-paced and the words are familiar to the learners (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Exceptions to this principle include: screens with no visuals, learners who are not native speakers of the course language, and placement of only a few keywords on the screen, including labeling critical elements of the graphic image for example (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). The expertise effect suggests that instructional methods, such as those described above, that are helpful to domain novices or low prior knowledge learners may have no effect or may even depress learning in high prior knowledge learners (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004).

It is important to note that the principles described above may not always hold true for non-laboratory contexts (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). For example, Muller found that adding approximately 50% additional extraneous but interesting material did not result in any significant difference in learner performance (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). There is ongoing debate concerning the mechanisms underlying these beneficial principles and on what boundary conditions may apply (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). These are debates in which both the learner and teacher should be active participants; not least because it will improve pedagogical approaches in the future (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti,

2009; British Future and Universities UK 2014). The next section focuses on the ways in which e-Learning borrows from traditional theory in order to bolster its credentials and effectiveness.

5.3. BORROWING FROM THE THEORIES OF LEARNING

Given its often shaky theoretical foundations, e-Learning has habitually borrowed and adapted traditional learning theories (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Good pedagogical practice has a theory of learning at its core (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). However, no single best-practice e-learning standard has emerged (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). This may be unlikely given the range of learning and teaching styles, the potential ways technology can be implemented and the ways in which educational technology itself is changing (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Various pedagogical approaches or learning theories may be considered in designing and interacting with e-learning programs (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). A case in point is the social-constructivist pedagogy which is particularly well afforded by the use of discussion forums, blogs, wiki, and online collaborative activities (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). It is a collaborative approach that opens educational content creation to a wider group, including the students themselves (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The one laptop per child (OLPC) Foundation attempted to use a constructivist approach in its project (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). In Figure 5.3, we see how the expectancy theory might explain the self-regulation aspects of internet use, a case of traditional theory being adapted to the realities of modern educational technologies (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998).

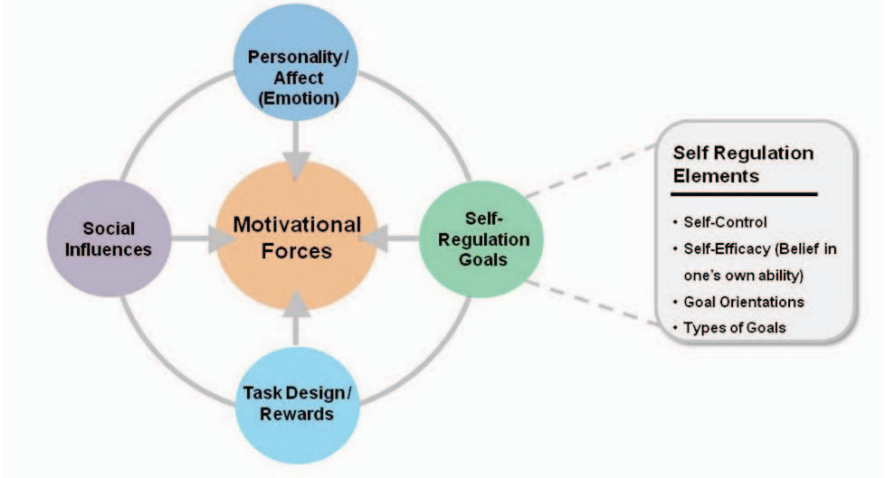

Figure 5.3: Expectancy theory and self-regulation.

Source: Penn State via PSU Wikispaces.

Many perspectives have been found to be effective in certain aspects of e-Learning. Laurillard's conversational model is also particularly relevant to eLearning (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Similarly, Gilly Salmon's Five-Stage Model is a pedagogical approach to the use of discussion boards (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Cognitive perspective focuses on the cognitive processes involved in learning as well as how the brain works (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Emotional perspective focuses on the emotional aspects of learning, like motivation, engagement, fun, and similar aspects (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Behavioral perspective focuses on the skills and behavioral outcomes of the learning process (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

Role-playing and application to on-the-job settings (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Contextual perspective focuses on the environmental and social aspects which can stimulate

learning (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Interaction with other people, collaborative discovery and the importance of peer support as well as pressure (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Mode neutral Convergence or promotion of 'transmodal' learning occurs where online and classroom learners can coexist within one learning environment thus encouraging interconnectivity and the harnessing of collective intelligence (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

For many theorists, it's the interaction between student and teacher and student and student in the online environment that enhances learning (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Pask's theory that learning occurs through conversations about a subject which in turn helps to make knowledge explicit has an obvious application to learning within a VLE (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Salmon developed a five-stage model of e-learning and e-moderating that for some time has had a major influence where online courses and online discussion forums have been used (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

In the Salmon five-stage model, individual access and the ability of students to use the technology are the first steps to involvement and achievement (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The second step involves students creating an identity online and finding others with whom to interact (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Hence, online socialization is a critical element of the e-learning process in this model (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In step 3 students are giving and sharing information relevant to the course to each other (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Collaborative interaction amongst students is central to step 4 in the model (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The 5th step in Salmon's model involves students looking for benefits from the system and using resources from outside of it

to deepen their learning (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Throughout all of this, the tutor/teacher/lecturer fulfills the role of moderator or e-moderator, acting as a facilitator of student learning (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The next section considers the role of e-learning in higher education.

5.4. ONLINE LEARNING IN HIGHER EDUCATION

Online learning involves courses offered by postsecondary institutions that are 100% virtual, excluding massively open online courses or MOOCs (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Online learning, or virtual classes offered over the internet, is contrasted with traditional courses taken in a brick-and-mortar school building (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). It is the newest development in distance education that began in the mid-1990s with the spread of the internet and the World Wide Web (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Learner experience is typically asynchronous, but may also incorporate synchronous elements (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The vast majority of institutions utilize a learning management system (LMS) for the administration of online courses (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). As theories of distance education evolve, digital technologies to support learning and pedagogy continue to transform as well (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Figure 5.4 demonstrates the exponential growth in global education. The introduction of educational technology will be a facilitative element in this market (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

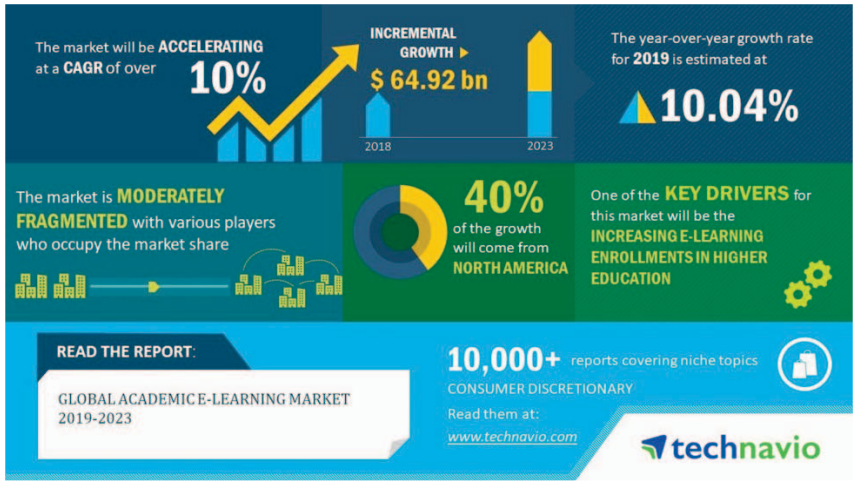

Figure 5.4: Global market in higher education.

Source: TechNavio via AP News.

Online credentials for learning are digital credentials that are offered in place of traditional paper credentials for a skill or educational achievement (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). These institutions are directly linked to the accelerated development of internet communication technologies (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). This has led to the development of digital badges, electronic passports and massive open online courses (MOOCs) which have a very direct bearing on our understanding of learning, recognition, and levels as they pose a direct challenge to the status quo (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). It is useful to distinguish between three forms of online credentials: Test-based credentials, online badges, and online certificates (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). The advent of pandemics such as COVID-19 means that many more institutions of higher learning will turn to the online modality as a matter of course, rather than as a matter of choice (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Some of the quality issues that this raises will be explored more later in the book. The final section in this chapter will specifically focus on the role and modalities of MOOCs.

5.5. MASSIVE OPEN ONLINE COURSE

A massive open online course (MOOC) is an online course aimed at unlimited participation and open access via the web (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In addition to traditional course materials, such as filmed lectures, readings, and problem sets, many MOOCs provide interactive courses with user forums or social media discussions (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

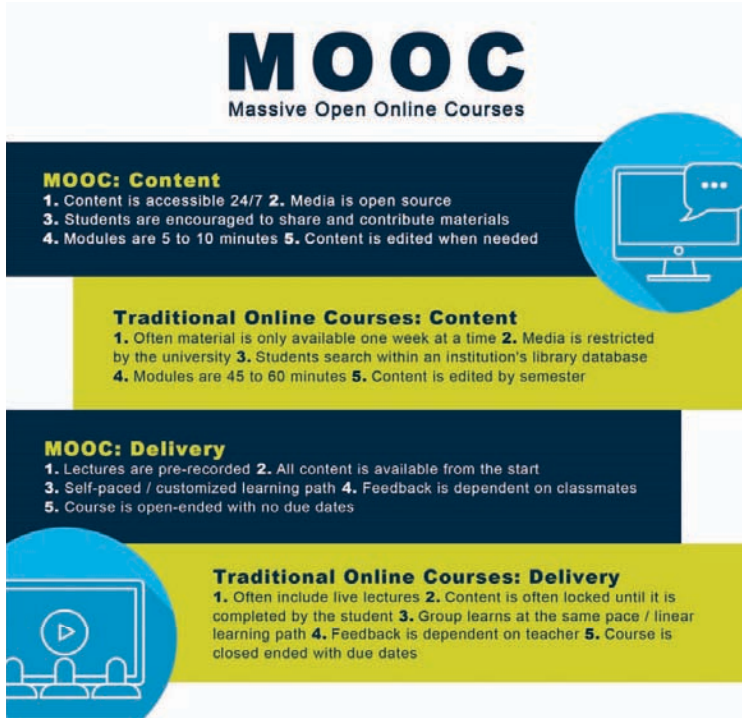

Figure 5.5: Massive open online course framework.

Source: A Pass Education.

These materials are utilized to support community interactions among students, professors, and teaching assistants, as well as immediate feedback to quick quizzes and assignments (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). MOOCs are a widely researched

development in distance education (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). They were first introduced in 2008, but really took off as a popular mode of learning in 2012 (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Figure 5.5 is an example of a framework for a MOOC.

Early MOOCs often emphasized open-access features, such as open licensing of content, structure, and learning goals, to promote the reuse and remixing of resources (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Some later MOOCs use closed licenses for their course materials while maintaining free access for students (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Before the Digital Age, distance learning appeared in the form of correspondence courses in the 1890s–1920s (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Later on, these modalities converted to radio and television broadcast of courses as examples of early forms of e-learning. Typically, fewer than 5% of the students would complete a course (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The 2000s saw changes in online, or e-learning and distance education, with increasing online presence, open learning opportunities, and the development of MOOCs (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). By 2010 audiences for the most popular college courses such as "Justice" with Michael J. Sandel and "Human Anatomy" with Marian Diamond were reaching millions (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

The first MOOCs emerged from the open educational resources (OER) movement, which was sparked by the MIT OpenCourseWare project (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). The OER movement was motivated from work by researchers who pointed out that class size and learning outcomes had no established connection, with Daniel Barwick's work being the most often-cited example (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Within the OER movement, the Wikiversity was founded in 2006 and the first open course on the platform was organized

in 2007 (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). A ten-week course with more than 70 students was used to test the idea of making Wikiversity an open and free platform for education in the tradition of Scandinavian free adult education, Folk High School and the free school movement (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

The term MOOC was coined in 2008 by Dave Cormier of the University of Prince Edward Island in response to a course called Connectivism and Connective Knowledge, also known as CCK08 (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). This development was led by George Siemens of Athabasca University and Stephen Downes of the National Research Council (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). It consisted of 25 tuition-paying students in Extended Education at the University of Manitoba, as well as over 2200 online students from the general public who paid nothing (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). All course content was available through RSS feeds, and online students could participate through collaborative tools, including blog posts, threaded discussions in Moodle, and Second Life meetings (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Stephen Downes considers these so-called ‘cMOOCs’ to be more “creative and dynamic” than the current ‘xMOOCs’ which some have critiqued as resembling television shows or digital textbooks (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010).

SUMMARY

This chapter has shown how a number of principles have been extracted from traditional educational theory in order to support the implementation of digital learning. The adaptation of that theoretical framework has been largely successfully, particular with regards to Mass Open Online Courses. However, there are still some practical challenges that are associated with the logistics of organizing that type of learning and also making it affordable as well as being accessible for the targeted audiences. The next chapter examines some of the innovations that have supported online learning in recent times.

Chapter

6 Innovations in Online Learning

CONTENTS

This chapter focuses on the innovative exercises that are taking place with regards to educational technologies. Some of these innovations include the emergence of new online courses, better focus on the value of student experiences, new instructional designs, support of the massive online course industry, and community engagement. By the end of this chapter, the reader should have a view on how educational technologies have been improving and addressing some of the challenges that they have faced along the way.

6.1. EMERGENCE OF NEW COURSES IN ONLINE LEARNING

Early cMOOCs such as CCK08 and ds106 used innovative pedagogy (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). This associated closely with distributed learning materials rather than a video-lecture format (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Additionally, there was a focus on education and learning and digital storytelling (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Following the 2011 launch of three Stanford xMOOCs, including 'Introduction into artificial intelligence (AI),' launched by Sebastian Thrun and Peter Norvig a number of other innovative courses have emerged (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). As of May 2014, more than 900 MOOCs are offered by US universities and colleges (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). By February 2013, dozens of universities had affiliated with MOOCs, including many international institutions (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). In addition, some organizations operate their own MOOCs including Google's Power Search (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The impact of the COVID-19 pandemic on school attendance rates (see Figure 6.1 for an example) is likely to herald a further explosion of online courses.

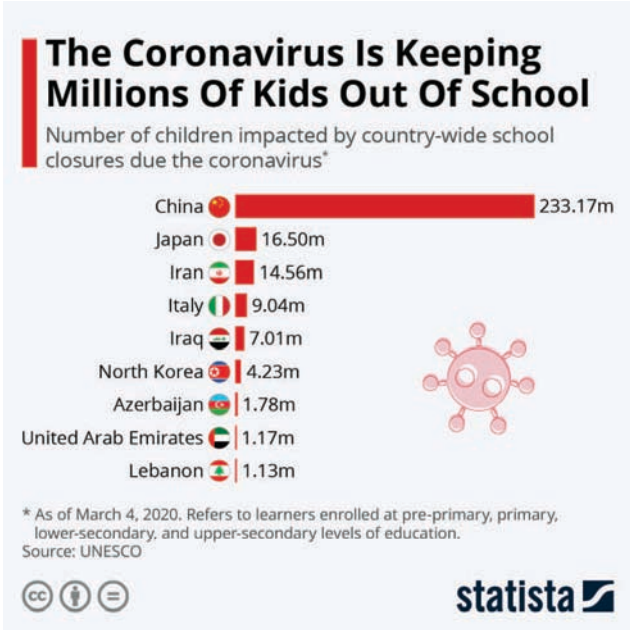

Figure 6.1: Impact of COVID-19 on school attendance.

Source: Statista via World Economic Forum.

A range of courses have emerged despite some earlier misgivings about how the courses would be received (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). There was a real question of whether this would work for humanities and social science which had discipline-specific pedagogical and research approaches (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). However, psychology and philosophy courses are among Coursera's most popular (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Student feedback and completion rates suggest that they are as successful as math and science courses (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). However, the corresponding completion rates are lower (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). In January 2012, the University of Helsinki launched a Finnish MOOC in programming (Aragon, 2003; Aras and Karakaya Polat, 2008; Association

of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The MOOC is used as a way to offer high-schools the opportunity to provide programming courses for their students, even if no local premises or faculty that can organize such courses exist (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The course has been offered recurrently, and the top-performing students are admitted to a BSc and MSc program in Computer Science at the University of Helsinki (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). At a meeting on E-Learning and MOOCs, Jaakko Kurhila, Head of studies for the University of Helsinki, Department of Computer Science, claimed that to date, there have been over 8000 participants in their MOOCs altogether (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

On 18 June 2012, Ali Lemus from Galileo University launched the first Latin American MOOC titled "Desarrollando Aplicaciones para iPhone y iPad" (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). This MOOC is a Spanish remix of Stanford University's popular "CS 193P iPhone Application Development" and had 5,380 students enrolled (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The technology used to host the MOOC was the Galileo educational system platform (GES) which is based on the LRN project (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). "Gender Through Comic Books" was a course taught by Ball State University's Christina Blanch on Instructure's Canvas Network, a MOOC platform launched in November 2012 (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). The course used examples from comic books to teach academic concepts about gender and perceptions (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). In November 2012, the University of Miami launched its first high school MOOC as part of Global Academy, its online high school (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). The course became available for high school students preparing for the SAT Subject Test in biology. During the Spring 2013 semester, Cathy Davidson and

Dan Ariely taught the "Surprise Endings: Social Science and Literature," a SPOC course taught in-person at Duke University and also as a MOOC, with students from Duke running the online discussions (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

In the UK of summer 2013, Physiopedia ran their first MOOC regarding Professional Ethics in collaboration with the University of the Western Cape in South Africa (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). This was followed by a second course in 2014, Physiotherapy Management of Spinal Cord Injuries, which was accredited by the World Confederation of Physical Therapy and attracted approximately 4000 participants with a 40% completion rate (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Physiopedia is the first provider of physiotherapy or physical therapy MOOCs, accessible to participants worldwide (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). In March 2013, Coursolve piloted a crowdsourced business strategy course for 100 organizations with the University of Virginia (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). A data science MOOC began in May 2013 (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). In May 2013, Coursera announced free e-books for some courses in partnership with Chegg, an online textbook-rental company (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Students would use Chegg's e-reader, which limits copying and printing and could use the book only while enrolled in the class (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

In June 2013, the University of North Carolina at Chapel Hill launched Skynet University which offers MOOCs on introductory astronomy (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Participants gain access to the university's global network of robotic telescopes, including those in the Chilean Andes and Australia (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). In July 2013, the University of Tasmania launched Understanding Dementia

(Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). The course had a completion rate of 39% and was recognized in the journal Nature (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Startup Veduca launched the first MOOCs in Brazil, in partnership with the University of São Paulo in June 2013 (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The first two courses were Basic Physics, taught by Vanderlei Salvador Bagnato, and Probability and Statistics, taught by Melvin Cymbalista and André Leme Fleury (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). In the first two weeks following the launch at Polytechnic School of the University of São Paulo, more than 10,000 students enrolled (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017).

Startup Wedubox (finalist at MassChallenge, 2013) launched the first MOOC in finance and third MOOC in Latam (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). the MOOC was created by Jorge Borrero (MBA Universidad de la Sabana) with the title "WACC and the cost of capital" (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). It reached 2500 students in Dec 2013, only 2 months after the launch (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). In the fall 2014, Georgia Institute of Technology launched the first MOOD (massive online open degree) for a Master's degree in computer science for $7000 by partnering with Udacity and AT&T (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In September 2014, the high street retailer, Marks, and Spencer partnered up with the University of Leeds to construct an MOOC business course which will use case studies from the Company Archive alongside research from the University to show how innovation and people are key to business success (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The course will be offered by the UK-based MOOC platform, FutureLearn (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). On 16 March 2015, the University of Cape Town launched its first MOOC, Medicine, and the Arts on the UK-led platform, Futurelearn (Collins, 2005;

Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). In July 2015, OpenClassrooms, jointly with IESA Multimedia, launches first MOOC-based Bachelor's degree in multimedia project management, recognized by French state (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). In January 2018, Brown University opened its first "game-ified" course on Edx (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Titled 'Fantastic Places, Unhuman Humans: Exploring Humanity Through Literature,' the course was led by Professor James Egan (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). It featured a storyline and plot to help Leila, a lost humanoid wandering different worlds, in which a learner had to play mini-games to advance through the course (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The Pacific Open Learning Health Net, set up by the WHO in 2003, developed an online learning platform in 2004–2005 for continuing development of health professionals (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Courses were originally delivered by Moodle, but were looking more like other MOOCs by 2012 (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In the next chapter, we consider the impact of student experiences on the adoption of educational technologies.

6.2. STUDENT EXPERIENCES OF ONLINE LEARNING

The student experience is an important aspect of any form of pedagogy, but more so in online learning where there is a lot of choice and students can easily drop out of courses (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). So far, online courses have proved to be very popular in terms of registration, but the completion rates are not as high as was once anticipated (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). By June 2012, more than 1.5 million people had registered for classes through Coursera, Udacity or edX (Aragon, 2003; Aras and Karakaya Polat, 2008;

Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). As of 2013, the range of students registered appears to be broad, diverse, and non-traditional, but concentrated among English-speakers in rich countries (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). By March 2013, Coursera alone had registered about 2.8 million learners (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). By October 2013, Coursera enrollment continued to surge, surpassing 5 million, while edX had independently reached 1.3 million (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Teachers have been making certain adjustments to their own working practices in order to reflect the needs and dictates of online learning (see Figure 6.2 for an example).

A course billed as "Asia's first MOOC" given by the Hong Kong University of Science and Technology through Coursera starting in April 2013 registered 17,000 students (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). About 60% were from "rich countries" with many of the rest from middle-income countries in Asia, South Africa, Brazil or Mexico (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Fewer students enrolled from areas with more limited access to the internet, and students from the People's Republic of China may have been discouraged by Chinese government policies (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Koller started in May 2013 that a majority of the people taking Coursera courses had already earned college degrees (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). According to a Stanford University study of a more general group of students "active learners" (i.e., anybody who participated beyond just registering) found that 64% of high school active learners were male and 88% were male for undergraduate- and graduate-level courses (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

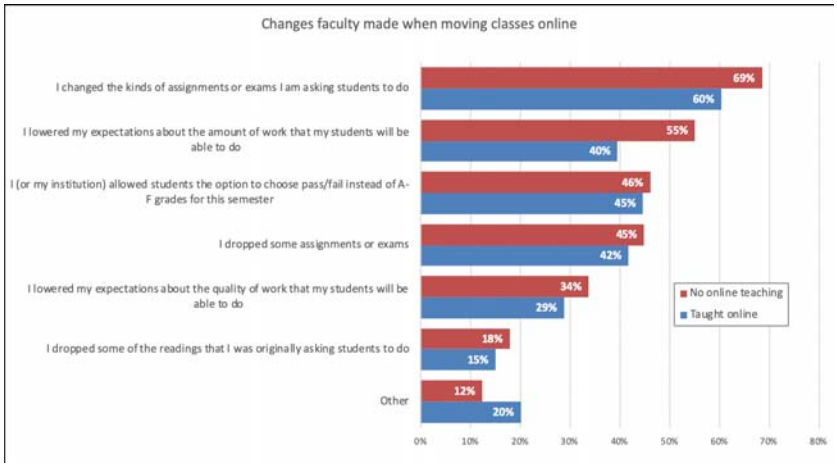

Figure 6.2: Changes teachers made in response to online learning.

Source: Lederman via Inside Higher Education.

A study from Stanford University's Learning Analytics group identified four types of students (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The first category consisted of auditors, who watched video throughout the course, but took few quizzes or exams (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). The second category included completers, who viewed most lectures and took part in most assessments (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The third category comprised disengaged learners, who quickly dropped the course (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). The 4th category was of sampling learners, who might only occasionally watch lectures. Jonathan Haber focused on questions of what students are learning and student demographics (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). About half the students taking US courses are from other countries and do not speak English as their first language (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). He found some courses to be meaningful, especially about reading comprehension (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman

and Bennett, 2014). Video lectures followed by multiple-choice questions can be challenging since they are often the 'right questions' (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Smaller discussion boards paradoxically offer the best conversations (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Larger discussions can be too thoughtful and misguided; with long discussions becoming rehashes or the same old stale left or right debate (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

MIT and Stanford University offered initial MOOCs in Computer Science and Electrical Engineering (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Since engineering courses need prerequisites so at the outset upper-level engineering courses were nearly absent from the MOOC list (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Now several universities are presenting undergraduate and advanced-level engineering courses. In 2013, the Chronicle of Higher Education surveyed 103 professors who had taught MOOCs (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Typically, a professor spent over 100 hours on the MOOC before it even started (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). This involved recording online lecture videos and doing other preparation (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). However, for some instructors, pre-class preparation comprised only a few dozen hours (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). The professors then spent 8–10 hours per week on the course, including participation in discussion forums (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010).

The medians were: 33,000 student enrollees; 2,600 passing; and 1 teaching assistant helping with the class (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). About 74% of the classes used automated grading, and 34% used peer grading (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Around 97%

of the instructors used original videos, 75% used open educational resources (OER) and 27% used other resources (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Moreover, 9% of the classes required a physical textbook and 5% required an e-book (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Unlike traditional courses, MOOCs require additional skills, provided by videographers, instructional designers, IT specialists, and platform specialists (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). Georgia Tech professor Karen Head reports that 19 people work on their MOOCs and that more are needed (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The platforms have availability requirements similar to media or content sharing websites, due to the large number of enrollees (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). MOOCs typically use cloud computing and are often created with authoring systems (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Authoring tools for the creation of MOOCs are specialized packages of educational software like Elicitus, IMC Content Studio and Lectora that are easy-to-use and support e-learning standards like SCORM and AICC (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). The next section focuses on instructional design in online learning.

6.3. INSTRUCTIONAL DESIGN IN ONLINE LEARNING

The instructional design that is required of online course varies when compared to traditional courses (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). Many MOOCs use video lectures, employing the old form of teaching (lecturing) using a new technology (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Thrun testified before the President's Council of Advisors on Science and Technology (PCAST) that MOOC courses are 'designed to be challenges,' not lectures (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka

and Okurut, 2006). Hence, the amount of data generated from these assessments can be evaluated 'massively using machine learning' at work behind the scenes (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). This approach dispels 'the medieval set of myths' guiding teacher efficacy and student outcomes. Instead, the approach replaces traditional techniques with evidence-based, 'modern, data-driven' educational methodologies that maybe the instruments responsible for a 'fundamental transformation of education' itself" (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Figure 6.3 demonstrates some of the differences between traditional online courses and MOOCs.

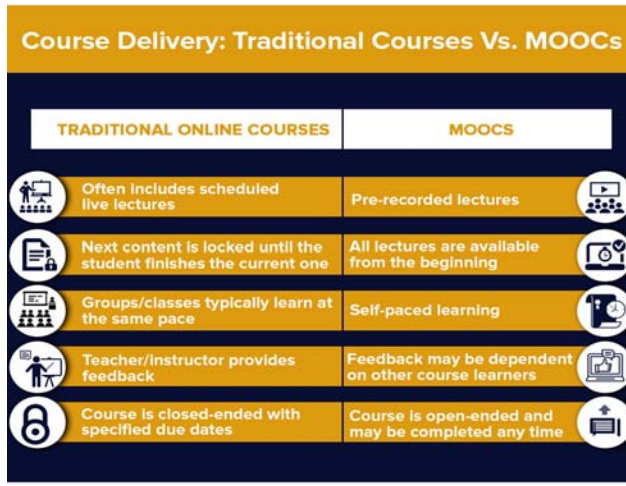

Figure 6.3: Comparing traditional online courses with MOOCs.

Source: University of Colorado via Guide2Research.

Some view the videos and other material produced by the MOOC as the next form of the textbook (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). A study of edX student habits found that certificate-earning students generally stop watching videos longer than 6 to 9 minutes (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). They viewed the first 4.4 minutes (median) of 12- to 15-minute videos. Some traditional schools

blend online and offline learning, sometimes called flipped classrooms (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Students watch lectures online at home and work on projects and interact with faculty while in class (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Such hybrids can even improve student performance in traditional in-person classes (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). One fall 2012 test by San Jose State and edX found that incorporating content from an online course into a for-credit campus-based course increased pass rates to 91% from as low as 55% without the online component (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

Because of massive enrollments, MOOCs require instructional design that facilitates large-scale feedback and interaction (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). The two basic approaches include first, peer-review, and group collaboration (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Secondly, they include automated feedback through objective, online assessments, e.g., quizzes and exams (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Machine grading of written assignments is also underway in many of these courses which would significantly reduce the administrative burden of managing exams (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). So-called connectivist MOOCs rely on the former approach; while broadcast MOOCs rely more on the latter (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). This marks a key distinction between cMOOCs where the ‘C’ stands for ‘connectivist,’ and xMOOCs where the x stands for extended (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Examples in literature include TEDx, edX. This represents that the MOOC is designed to be in addition to something else, a case in point being university courses (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

Assessment can be the most difficult activity to conduct online, and online assessments can be quite different from the brick-and-mortar version (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Special attention has been devoted to proctoring and cheating (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Peer review is often based upon sample answers or rubrics, which guide the grader on how many points to award different answers (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). These rubrics cannot be as complex for peer grading as for teaching assistants (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Students are expected to learn via grading others and become more engaged with the course. Exams may be proctored at regional testing centers (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Other methods, including "eavesdropping technologies worthy of the C.I.A." allow testing at home or office, by using webcams, or monitoring mouse clicks and typing styles (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Special techniques such as adaptive testing may be used, where the test tailors itself given the student's previous answers, giving harder or easier questions accordingly (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Experts opine that the most important thing that helps students succeed in an online course is interpersonal interaction and support (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

Assigning mentors to students is another interaction-enhancing technique (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). In 2013 Harvard offered a popular class, The Ancient Greek Hero, instructed by Gregory Nagy and taken by thousands of Harvard students over prior decades (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). It appealed to alumni to volunteer as online mentors and discussion group managers (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). About 10 former teaching fellows also volunteered. The task of the

volunteers, which required 3–5 hours per week, was to focus on online class discussion. The edX course registered 27,000 students. Research by Kop and Fournier highlighted as major challenges the lack of social presence and the high level of autonomy required. Techniques for maintaining connection with students include adding audio comments on assignments instead of writing them, participating with students in the discussion forums, asking brief questions in the middle of the lecture, updating weekly videos about the course and sending congratulatory emails on prior accomplishments to students who are slightly behind (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Grading by peer review has had mixed results (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). In one example, three fellow students grade one assignment for each assignment that they submit. The grading key or rubric tends to focus the grading, but discourages more creative writing. This chapter will close with a section on communities in online learning.

6.4. THE ONLINE LEARNING COMMUNITY

Over time, an online learning community has developed and been supported by a range of educational technologies (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). An online learning community is a public or private destination on the internet that addresses the learning needs of its members by facilitating peer-to-peer learning (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Through social networking and CMC, or the use of datagogies while people work as a community to achieve a shared learning objective (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Learning objectives may be proposed by the community owner or may arise out of discussions between participants that reflect personal interests (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). In an online learning community, people share knowledge via textual discussion (synchronous or asynchronous), audio, video, or other Internet-supported media (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Blogs blend personal journaling with social networking to create environments with opportunities for reflection (Collins, 2005;

Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). According to Etienne Wenger, online learning communities are environments conducive to communities of practice (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Figure 6.4 is a representation of an online learning community.

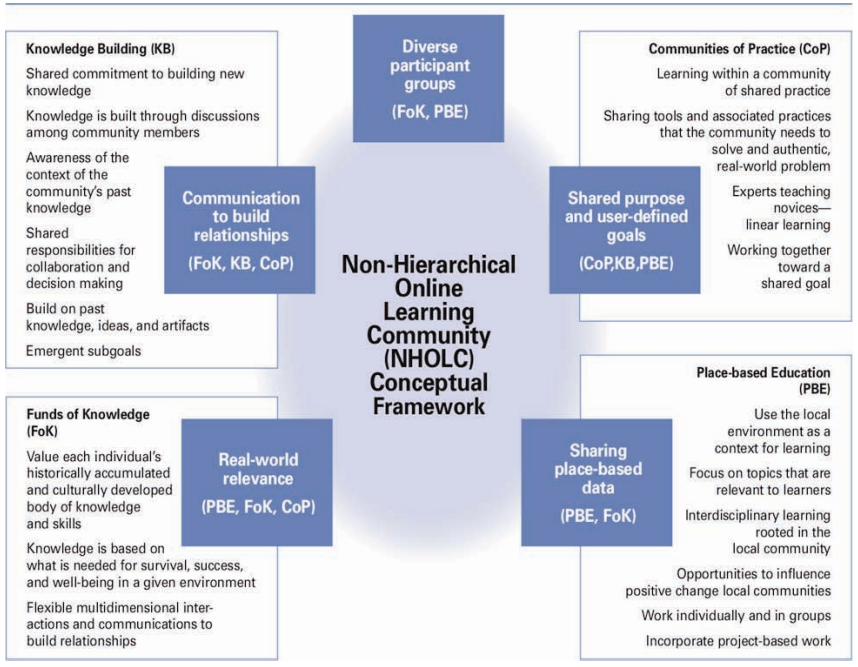

Figure 6.4: The online learning community.

Source: Semantic Scholar.

The online learning communities have been divided into various categories over time (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Types of online learning communities include e-learning communities where groups interact and connect solely via technology (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). The alternative is blended learning communities in which groups utilize face-to-face meetings as well as online meetings (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Moreover,

intentional online learning communities may be categorized as knowledge-based, practice-based, and task-based (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Online learning communities may focus on personal aspects, process, or technology (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). They may use technology and tools in many categories (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Some of these include synchronous such as instant messaging or language exchange websites and mobile applications (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Alternatively, they can be asynchronous, such as message boards and Internet forums (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). Classifications may cover blogs, course management, collaborative (e.g., wikis), social networking, social learning, online universities, as well as skills and language exchange platforms (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003).

A wiki is a hypertext publication collaboratively edited and managed by its own audience directly using a web browser (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). A typical wiki contains multiple pages for the subjects or scope of the project and maybe either open to the public or limited to use within an organization for maintaining its internal knowledge base (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). Wikis are enabled by wiki software, otherwise known as wiki engines (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). A wiki engine, being a form of a content management system (CMS), differs from other web-based systems such as blog software, in that the content is created without any defined owner or leader, and wikis have little inherent structure, allowing the structure to emerge according to the needs of the users (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Wiki engines usually allow content to be written using a simplified markup language and sometimes edited with the help of a rich-text editor (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen,

and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). There are different wiki engines in use, both standalone and part of other software, such as bug tracking systems (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Some wiki engines are open source, whereas others are proprietary (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Some permit control over different functions or levels of access (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Some of these access modalities may include editing rights that may permit changing, adding, or removing material (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Others may permit access without enforcing access control. Other rules may be imposed to organize content (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995).

SUMMARY

This chapter has highlighted some creative and practical innovations for online education; they include new courses, student experiences, innovative designs, and the formation of online learning communities. The next chapter will highlight some of the accreditation issues that have been experienced in the online learning industry.

Chapter

7 Accreditation and Quality Issues in Online Education

CONTENTS

One of the key outcomes for online education is an accredited and acceptable qualification. Unfortunately, the issue of accreditation and the quality of online education have remained constant problems. This chapter explores some of the more common online qualifications and their relative merits or demerits. These include the online degree, virtual universities, and the role of the distance education accreditation commission. All these go to the heart of what it means to be an online tutor or learner in what is in effective a virtual learning environment (VLE). By the end of this chapter, the reader should be able to link the nature of online education and its current status in terms of accreditation and acceptability.

7.1. THE ONLINE DEGREE

An online degree is an academic degree (usually a college degree, but sometimes the term includes high school diplomas and non-degree certificate programs) that can be earned primarily or entirely through the use of an Internet-connected computer (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). This is opposed to attending college in a traditional campus setting (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004).

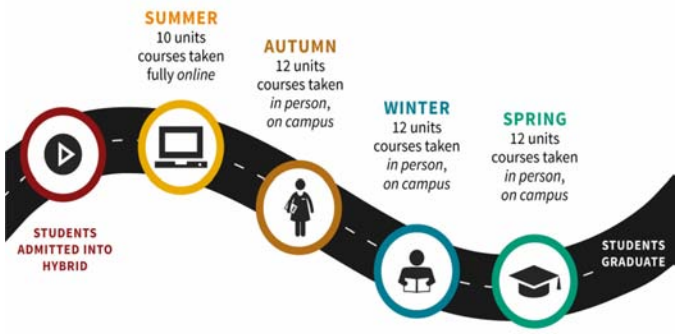

Figure 7.1: Example of an online degree design.

Source: Gadgets Now.

Improvements in technology, the increasing use of the Internet worldwide, and the need for people to have flexible school schedules while they are working have led to a proliferation of online colleges that award associate, bachelor's, master's, and doctoral degrees (Joshua, Nehemiah,

and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Figure 7.1 is an example of how an online degree might be organized, managed, and delivered.

The goal of educational accreditation, according to the United States Department of Education, is to ensure that programs provided by institutions of higher education meet acceptable levels of quality (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). ENQA, the European Association for Quality Assurance in Higher Education, describes the role of external quality assurance in education as one that combines both accountability for the reassurance of the public and an objective and developmental role for enhancing quality in institutions (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). In the area of online education, it is important to avoid unaccredited diploma mills that offer fake degrees, as these are unfortunately common (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Students seeking valid online degrees should obtain proof of accreditation from an appropriate national or regional accrediting body (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010).

In the United States, online colleges that are fully accredited have earned a widely recognized form of university accreditation from either one of the six regional accreditation boards, one of the six national accreditation boards, or one of the four national faith-based accreditation boards (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). Each of six geographic regions of the United States has one regional accreditation board, a non-governmental agency that oversees and accredits degree-granting institutions headquartered in their areas (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). Outside of the United States, other national and regional standards of accreditation hold, and maybe highly supportive of, distance education (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). For example, the Universitat Oberta de Catalunya, or Open University (OU) of Catalonia, has been accredited by AQU, the Agency for Quality Assurance in the Catalan University System (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). It is a full member of ENQA

since its inception in 1995 (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Hence, it has been called a significant success story as the world's first continuous and sustainable, virtual university (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). Similarly, in Ireland, the Higher Education and Training Awards Council (HETAC) has accredited a number of online colleges and degrees, such as the Setanta College (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

Online education enables individuals living with physical disabilities, full-time employees, military personnel, those living abroad, and stay-at-home parents, among others to have access to accredited higher education (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). The perception of the quality of online degrees compared to on-campus degrees varies, but has been increasing in recent years (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). While most major online colleges are regionally accredited, the public estimation of their quality is in dispute (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). A national survey of hiring representatives showed that a preference toward on-campus degrees exists (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In some instances, hiring executives were unwilling to consider applicants with an online degree. Some experts argue that degrees in certain fields are more accepted online than in others, while some programs are less suited for online-only schools (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). A major issue for accredited and reputable online programs is the proliferation of proprietary online-only programs that have come under significant criticism in recent years (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006).

A survey by the Distance Education Accrediting Commission (DEAC) found that 100% of employers who responded felt that distance education program graduates performed better on the job as a result of their degree, as compared to their previous performance (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire,

2014; Heron, 2006). Additionally, employers felt that an employee receiving a distance education degree compared favorably, in terms of knowledge learned, to someone with a resident degree (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). On the other hand, The Chronicle of Higher Education reported in January 2007 on a Vault Inc. survey that found 55% of employers preferred traditional degrees over online ones (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). However, 41% indicated that they would give equal consideration to both types of degrees. The Sloan Consortium, an organization funded by the Alfred P. Sloan Foundation to maintain and improve the quality of distance education, publishes regular reports on the state of United States distance education (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). In the next section, we consider the structure and role of a virtual university.

7.2. THE VIRTUAL UNIVERSITY

A virtual university provides higher education programs through electronic media, typically the Internet (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Some are bricks-and-mortar institutions that provide online learning as part of their extended university courses while others solely offer online courses (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). They are regarded as a form of distance education (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). The goal of virtual universities is to provide access to the part of the population who would not be able to attend a physical campus (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001).

Students may opt for this kind of education for reasons such as distance and the need for flexibility (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Some of these organizations exist only as loosely tied combines of universities, institutes or departments (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018;

National Council for Special Education, 2013). They together provide a number of courses over the Internet, television or other media (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). These programs are separate and distinct from programs offered by the single institution outside of the combine (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Figure 7.2 is an example of a virtual university.

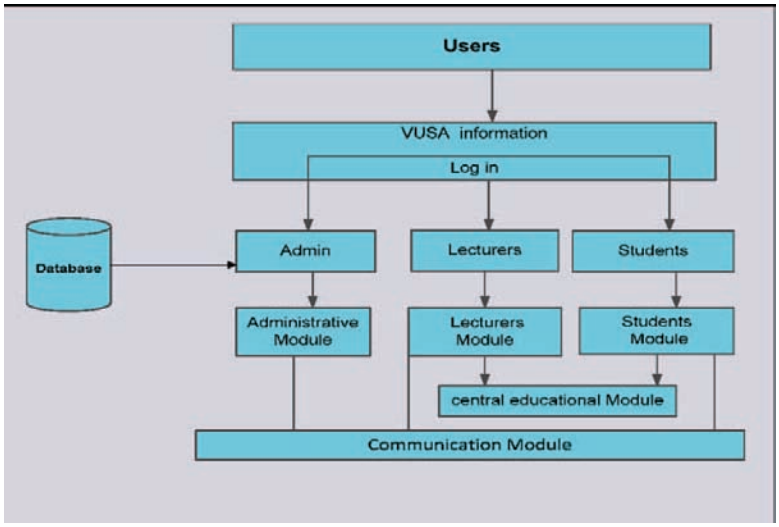

Figure 7.2: Example of an analytical view of a virtual university.

Source: Semantic Scholar.

Others are individual organizations with a legal framework, yet are called "virtual" because they appear only on the Internet, without a physical location aside from their administration units (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Still other virtual universities can be organized through specific or multiple physical locations, with or without actual campuses to receive program delivery through technological media that is broadcast from another location where professors give televised lectures (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Program delivery in a virtual university is administered through Information and communications technology such as web pages, e-mail, and other networked sources (Jansson, Bukuluki, and Hojer, 2017;

Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). As virtual universities are relatively new and vary widely, questions remain about accreditation and the quality of assessment (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001).

The defining characteristic of all forms and generations of distance education is the separation of student and teacher in time and space (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Distance education can be seen as the precursor to online learning (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Before the advent of virtual universities, many higher education institutions offered some distance education through print-based correspondence courses (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). These courses were often referred to as a 'course in a box' (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). These have been developed so that students can obtain almost immediate feedback from professors and online tutors through e-mails or online discussions (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). When the term "virtual" was first coined in the computational sense, it applied to things that were simulated by the computer, like virtual memory (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Over time, the adjective has been applied to things that physically exist and are created or carried on by means of computers (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010).

The OU in the United Kingdom was the world's first successful distance teaching university (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). It was founded in the 1960s on the belief that communications technology could bring high quality degree-level learning to people who had not had the opportunity to attend campus universities (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). With the goal of bringing higher education to all those who wanted to access it, the committee came up with various scenarios before settling on the name OU (Sawiuk, Taylor, and Groom,

2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). The first idea floated in the UK was to have a "teleuniversity" which would combine broadcast lectures with correspondence texts and visits to conventional universities (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In the "teleuniversity" scenario courses are taught on the radio and television and in fact many universities adopted the use of this technology for their distance education courses (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006).

The name "teleuniversity" morphed into the "University of Air" which still had the same goal of reaching the lower-income groups who did not have access to higher education (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). The name "University of Air" did not stick and by the time the first students were admitted in January 1971 the name had become what it is today "OU" (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). OU proved that it was possible to teach university-level courses to students at a distance (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). By 1980, total student numbers at OU had reached 70,000 and some 6,000 people were graduating each year (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). The 1980s saw increased expansion continue as more courses and subject areas were introduced (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). As the importance of career development grew, so the university began to offer professional training courses alongside its academic programs (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). By the mid-nineties, the OU was using the internet (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). As of 2008, more than 180,000 students were interacting with OU online from home (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016).

Taking courses online means that students will be learning in their own time by reading course material, working on course activities, writing assignments and perhaps working with other students through interactive

teleconferences (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Online learning can be an isolating experience since the student spends the majority of their time working by themselves (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Some learners do not mind this kind of solo learning, but others find it a major stumbling block to the successful completion of courses (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Because of the potential difficulty of maintaining the schedule needed to be successful when learning online, some virtual universities apply the same type of time management as traditional schools (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Many courses operate to a timetable, which the student receives with the course materials (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). These may include the planned activities for each week of the course and due dates for the assignments (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). If the course has an exam, the students will be informed where they have to go to write it (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014).

An example of a university that maintains a tight schedule is the Virtual Global University (VGU) in Germany (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). VGU offers a graduate program "International Master of Business Informatics" or MBI (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). This is a master program in information technology and management that takes an average of four semesters to complete for full-time students (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Each course has a lecture or a virtual class meeting every week. Afterwards, students get a homework assignment. For example, they have to solve an exercise, elaborate on some problem, discuss a case study, or take a test. Lecturers give them immediate feedback, and one week later, the process is repeated. Coursework can be the same for a Virtual University as the On-campus University in certain cases. NYU Tandon Online, for example, provides the same course work to its online students as the on-campus students at the NYU Tandon School

of Engineering (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). This is done using advanced technologies (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014).

When online courses first began, the primary mode of delivery was through a two-way audio-visual network (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Then as well as now, many of the virtual study programs were mainly based on text documents, but multimedia technologies have become increasingly popular as well (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). These web-based delivery modes are used in order to expand access to programs and services that can be offered anytime and anywhere (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). The spectrum of teaching modes in virtual education includes courses based on hypertext, videos, audios, e-mails, and video conferencing (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Teaching on the web through courseware such as WebCT and Blackboard are also used (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007).

Students taking "virtual" courses are doing real work to get their degrees, and educators preparing and teaching those courses spend real time in doing so (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). In that sense, students meet a comparable level of academic learning outcomes and are evaluated through programs constructed according to standard university-level criteria (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). Nevertheless, it should not be assumed, virtual universities may be accredited in the same way as traditional universities and operate according to a similar set of academic standards (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). Indeed, questions remain about accreditation and the quality of assessment (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Accreditation is required to assure students that the online institute has certified online instructors who have the expertise and educational qualifications to design and carry out the

curriculum (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Assessment standards need to be particularly closely monitored in virtual universities (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). For example, respondents in studies of opinions about online degrees will rate an online degree from Stanford the same as an on-campus degree, because the name of the granting institution is recognized (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). We explore a specific commission that focuses on accreditation in the next section.

7.3. DISTANCE EDUCATION ACCREDITING COMMISSION (DEAC)

The DEAC was formerly known as the National Home Study Council (NHSC) and then as the Distance Education and Training Council (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). It is a non-profit national educational accreditation agency in the United States specializing in the accreditation of distance education programs of study and institutions (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Recent statistics indicate that DEAC covers about 51% of all institutions that could potentially fall within its remit (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). The DEAC was established in 1926 as the NHSC, a trade association for correspondence schools (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Its formation was in response to a Carnegie Corporation study that found a lack of standards to ensure quality in correspondence schools and protect their students and the public from fraud (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Figure 7.3 highlights the evolution of DEAC from 1926 to 2015.

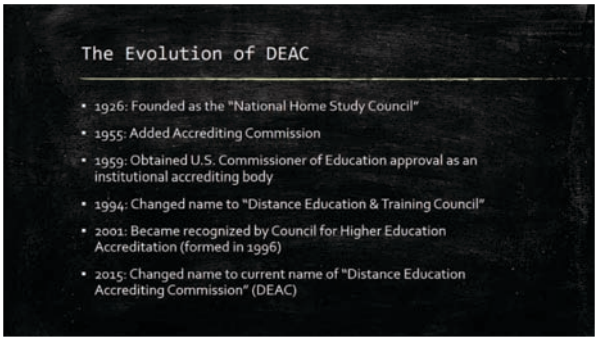

Figure 7.3: Evolution of the distance education accrediting commission.

Source: DEAC via YouTube.

Under its first director, John Noffsinger, the NHSC developed a list of minimum standards for proprietary schools (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). The NHSC adopted the name Distance Education and Training Council in 1994 and its current name in 2014 (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010). During the same year, Dr. Leah Matthews (Chief Executive Officer and Executive Director of DEAC) wrote an article that attributes distance education learning vs. traditional learning in part, to constant changes in the education landscape (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). According to this chapter, distance education institutions are uniquely positioned to meet the changing demands for enhanced technologies and higher education program delivery (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Some competitors and commentators this as a threat to the traditional higher education model as opposed to a strategic opportunity (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). However, technology-enhanced learning (TEL) has the potential to transform higher education accessibility and raise the level of education attained globally (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

In 1959 the NHSC was formally recognized by the U.S. Office of Education as an accreditor of higher education institutions (Dziuban et al.,

2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Currently the DEAC is recognized by Council for Higher Education Accreditation (CHEA) and the United States Department of Education as an accreditor of institutions of higher education (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). According to the DEAC, it is made up of over 100 distance education institutions located in 21 states and 7 countries (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). These institutions include non-profit institutions, trade associations, for-profit companies, colleges, and universities, and military organizations (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). The DEAC has strict criteria for approving schools for accreditation, and the process includes examining the schools' educational, ethical, and business practices (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001).

DEAC is a national accreditor category and also uses independent subject specialists drawn primarily from regionally accredited institutions to review the courses or programs of applicants for accreditation or reaccreditation (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The institution is actively involved in evaluating any new programs (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). DEAC shares many of the same subject specialist evaluators working in regionally accredited higher education institutions used by the American Council on Education for its Credit Recommendation reviews (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). Each college or university cannot guarantee acceptance of transfer credits and the receiving college or university formulates its own transfer credit policies for admission (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). It is the receiving college or universities responsibility to provide reasonable and definitive transfer policies and to fairly judge the quality and quantity of the transfer students work (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). The CHEA offered an opinion in a November 2000 statement that Institutions and accreditors need to assure

that transfer decisions are not made solely on the source of accreditation of a sending program or institution (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). The higher education transfer alliance (HETA) online directory was designed by DEAC to help students and the public find educational institutions with transfer practices consistent with criteria (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). This was articulated by CHEA in its Statement to the Community: Transfer and Public Interest. According to CHEA, institutions that are members of HETA have agreed that their transfer decisions are not made solely on the basis of the accredited status of a sending institution and that the institution has agreed at least to consider transfer requests from other institutions (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). The HETA directory provides links to member institutions so that students and others can review a specific institution's transfer policies and practice (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

Educational accreditation is a quality assurance process under which services and operations of educational institutions or programs are evaluated and verified by an external body to determine if applicable and recognized standards are met (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). If standards are met, accredited status is granted by the appropriate agency (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). In most countries, the function of educational accreditation is conducted by a government organization, such as a Ministry of Education (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). The United States government instead delegates the quality assurance process to private non-profit organizations (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). Those organizations are formally called accreditors (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

In order to receive federal funding and any other type of federal recognition, all accreditors in the US must in turn be recognized by the National Advisory Committee on Institutional Quality and Integrity or NACIQI (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015;

Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). This is an advisory body to the U.S. Secretary of Education. The federal government is therefore still the top-level architect and controlling authority of accreditation (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). The U.S. accreditation process was developed in the late 19th century and early 20th century (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). This was after educational institutions perceived a need for improved coordination and articulation between secondary and post-secondary educational institutions, along with standardization of requirements between the two levels (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). The next section assesses the state of online tutoring.

7.4. ONLINE TUTORING

Online tutoring is the process of tutoring in an online, virtual, or networked, environment, in which teachers and learners participate from separate physical locations (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Aside from space, literature also states that participants can be separated by time (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Online tutoring is practiced using many different approaches for distinct sets of users (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The distinctions are in content and user interface, as well as in tutoring styles and tutor-training methodologies (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004).

Definitions associated with online tutoring vary widely (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). First, they reflect the ongoing evolution of the technology (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). Secondly, they are associated with the refinement and variation in online learning methodology (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Reference may be made to the interactions of

the organizations that deliver online tutoring services with the institutions, individuals, and learners that employ the services (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). This Internet-based service is a form of micropublishing (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). Figure 7.4 highlights the typical learning environment that might be used for tutoring online.

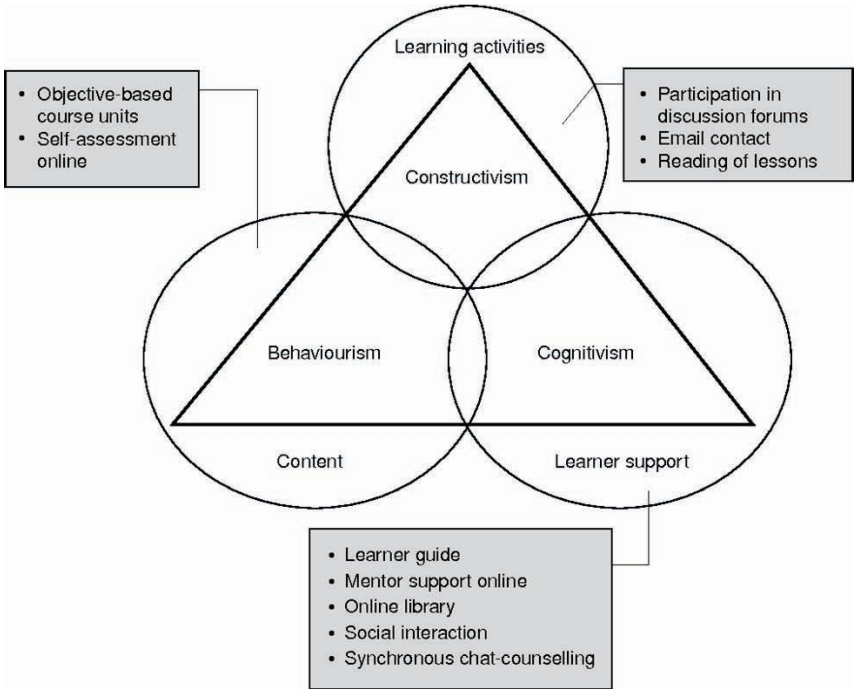

Figure 7.4: Design framework for online learning environments.

Source: Semantic Scholar.

An institution can offer online tutoring through an internal or external tutoring website or through a learning management system or LMS (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). Online environments applied in education could also involve the use of a virtual learning environment (VLE) platform such as Moodle, Sakai, WebCT, Blackboard (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). Some of these are paid systems, but some are free and open-source

such as Google+ Hangouts (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Online tutoring may be offered either via a link in an LMS, or directly through the tutoring service's platform, where the subscriber may be required to pay for tutoring time before the delivery of service (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Many educational institutions and major textbook publishers sponsor a certain amount of tutoring without a direct charge to the learner (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014).

Tutoring may take the form of a group of learners simultaneously logged in online, then receiving instruction from a single tutor, also known as many-to-one tutoring and live online tutoring (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). This is often known as e-moderation (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). It is defined as the facilitation of the achievement of goals of independent learning, learner autonomy, self-reflection, knowledge construction, collaborative or group-based learning, online discussion, transformative learning and communities of practice (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995).

These functions of moderation are based on constructivist or social-constructivist principles of learning (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). Another form of tutoring, called peer tutoring, connects peers, such as recent or fellow students within a course or subject, tutoring each other (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). This may also be conducted as online tutoring over an online conferencing interface (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). A more common approach is where individual learners or their parents purchase tutoring time with a private vendor of online tutoring service (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Such time may also be made available through the purchase of a book, access to a library, a textbook publisher, or enrollment in a particular school or school system (Farhadi, 2019; Farnham and Horton,

1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). This is known as one-on-one tutoring (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). This chapter will close with a review of the virtual school environment.

7.5. THE VIRTUAL SCHOOL ENVIRONMENT

An online school (virtual school or e-school or cyber-school) teaches students entirely or primarily online or through the Internet (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). It has been defined as education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Online education exists all around the world and is used for all levels of education such as K-12, college, or graduate school (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). This type of learning enables the individuals to earn transferable credits, take recognized examinations, or advance to the next level of education over the Internet (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004).

Virtual education is most commonly used at the high school or college level (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Students who are of the age 30 or older, tend to study online programs at higher rates (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). This group represents 41% of the online education population, while 35.5% of students ages 24–29 and 24.5% of students ages 15–23 participate in virtual education (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Figure 7.5 highlights the state of the market for virtual schools in North America as a case in point.

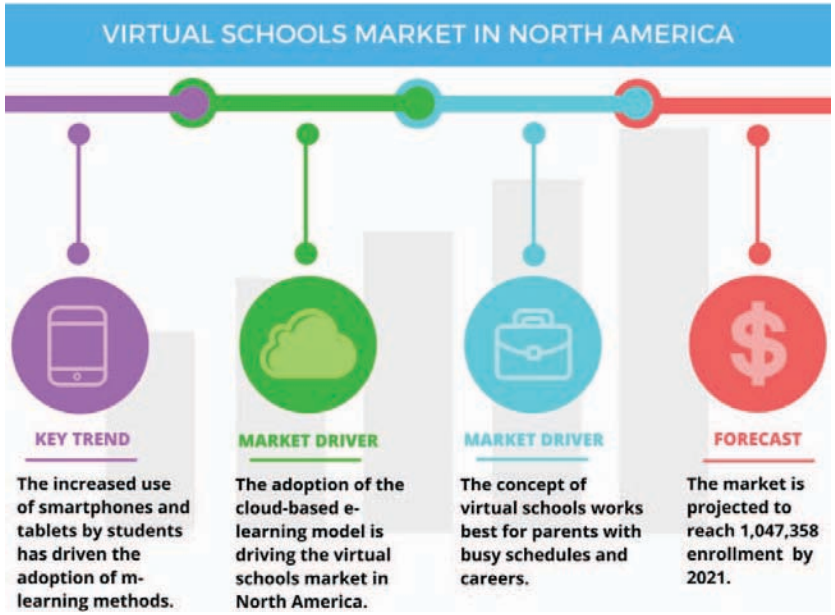

Figure 7.5: Virtual schools' market in North America.

Source: Business Wire.

Virtual education is becoming increasingly used worldwide (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). There are currently more than 4,700 colleges and universities that provide online courses to their students (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). In 2015, more than 6 million students were taking at least one course online (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). This number grew by 3.9% from the previous year (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). Around 30% of all higher education students are taking at least one distance course (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The total number of students studying on campus exclusively dropped by 931,317 people between the years 2012 and 2015 (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). Experts say that because the number of students studying at the college level is growing, there will also be an

increase in the number of students enrolled in distance learning (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010).

Instructional models vary, ranging from distance learning types which provide study materials for independent self-paced study, to live, interactive classes where students communicate with a teacher in a class group lesson (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Class sizes range widely from a small group of 6 pupils or students to hundreds in a virtual school (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). The courses that are independent and self-paced are called asynchronous courses (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995).

Typically for this type of learning, the students are given the assignments and information and are expected to complete the assignments by the due date (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). This is done on their own time. There is no scheduled time when the class meets (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Usually, the only interactions that take place are through discussion boards, blogs, and wikis (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). On the other hand, synchronous online courses happen in real-time (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The instructor and students all interact online at the same time (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). This is done either through text, video, or audio chat (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Therefore, these lessons are socially constructed (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). In addition to the scheduled class time, there are usually additional assignments to complete (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014).

Hybrid, sometimes also called blended, courses are when students learn and interact both in-person and online (Kötter, 2002; Koza, 1993; Krueger and Lindahl, 2000; Kumar et al., 2017; Kusuma and Akhiruyanto, 2019; Ladson-Billings, 1995). These classes meet in person during the semester in addition to computer-based communication (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The mid-1990s saw the advent of completely virtual schools (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Many of today's virtual schools are descendants of correspondence schools (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). The earlier online schools began in Australia, New Zealand, North America and the UK, generally in areas where low-density population made schooling by conventional means difficult and expensive to provide (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). In 2008 an assessment found high dropout rates (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). As in other computerized environments, once the glamour of the new methods wore off, it became clear that human skills were paramount to success, in this case, teaching, and welfare expertise (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006).

SUMMARY

This penultimate chapter has focused on the challenges that online education has found in terms of its accreditation and delivery processes. Nevertheless, the chapter has highlighted important concepts and modalities including an online degree, virtual universities, accrediting commissions, online tutoring, and the virtual school environment. The final chapter will highlight examples of a wider application of educational technologies.

Chapter

8 Wider Application of Online Technologies

CONTENTS

Despite a host of challenges, online technologies have found a wider application beyond their original conceptualization. Some of these include the development of school websites, virtual campuses, mobile learning, instructional simulation, and learning management systems (LMSs). By the end of this final chapter, the reader will have an overview of certain possibilities of applying educational technologies in the real world.

8.1. THE SCHOOL WEBSITE

The classic school website is a website built, designed, and maintained by a school (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). In many legislations, it is a statutory requirement for schools to publish certain information online, on their website, or elsewhere (Palvia et al., 2017; Parker, 2004; Pickton and Broderick, 2005; Pierpaolo and Antonia, 2018; Pill, 2008; Plake and Wise, 2014). School website software is a specialized form of content management system (CMS) hosted on a computer connected to the internet (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). It is commissioned by the school governors. Typically, it will be designed and installed by a specialist computer software company (Collins, 2005; Cooper and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). When it has been accepted, the client (the school) is responsible for maintaining the content; adding new content and changing elements of the visual design (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). The visitor to the site cannot make these changes but accesses the site to read the content (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). CMS may have additional modules that allow it to do additional tasks-like mass e-mailing, online registration for events or even online sales (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Figure 8.1 is an example of a university website that uses principles that are very similar to the ones used for a school website.

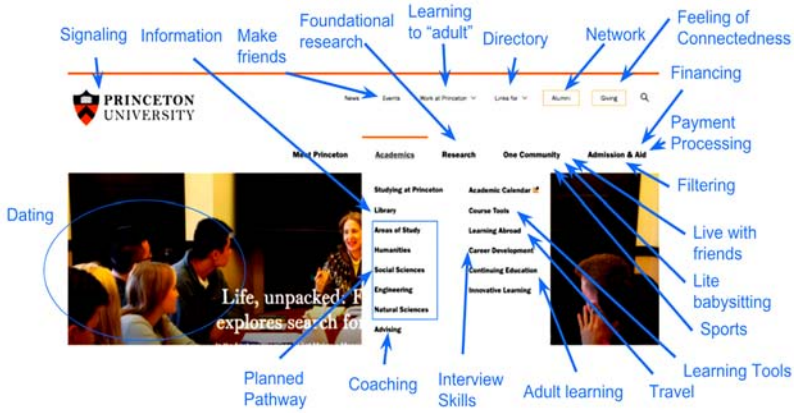

Figure 8.1: Example of a university website.

Source: Princeton University.

School websites can be relatively simple and therefore follow proven models, with just the text and the images customized to the school's requirements or bespoke, or part of a larger management suite (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). The basic content of the website is to large part be defined by the government (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). The content of the website must comply with data protection legislation (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Websites cannot be static, legislation changes and also the needs of the school (Liu, 2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). If the website is being used as a method of school promotion, then-current style and fashion is important (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). The rise of mobile phone use among parents means that the site has to be optimized for mobile browsers as well as the laptop or PC (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). In the next section, we will look at the virtual campus.

8.2. THE VIRTUAL CAMPUS

A virtual campus or e campus, refers to the online offerings of a college or university where college work is completed either partially or wholly online, often with the assistance of the teacher, professor, or teaching assistant (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). Many colleges and universities now offer such courses (or entire degree programs) either partially or wholly online (Hess and Wilson, 2000; Hillier, 2018; Hoffman and Novak, 2009; Holt, Ward, and Wallhead, 2006; Hoover, 2017). There are an estimated 4,500 such institutions with total enrollments approaching perhaps 2 million (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016).

Schools use a variety of tools for conducting classes (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). These are typically called learning management systems (LMS) or course management systems or CMS (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). In some literature, CMS may also refer to content management systems (Beaudoin, 2002; Benton and Craib, 2010; Bettmann et al., 2009; Beytell, 2014; Biesta and Burbules, 2003; Billis, 2010).

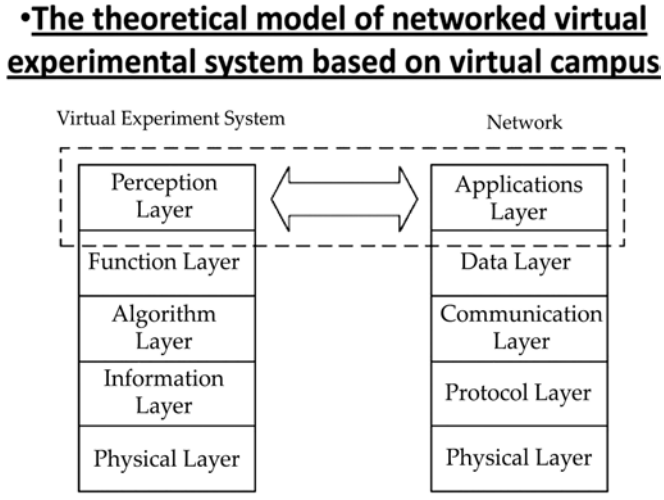

Figure 8.2: Prototype of a virtual campus.

Source: Slide Player.

Some of the aspects that go under virtual campus includes various types of learning activities such as lectures, homework, discussions, readings, assignments (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). Figure 8.2 represents an example of a prototype virtual campus.

Classes are usually self-paced using online documents and databases that might be available to them (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). Tests and other assignments are available online in specific programs used for online classes. Other methods used in virtual campus are live sessions, videoconferencing, discussing, and sharing various applications (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Individuals are able to access the materials any time they want under the teacher's control and are able to access anywhere online where they're able to access internet usage (Popovich and Neel, 2005; Porter et al., 2016; PTI 2015; Pychyl, 2008; Qu, 2015; Rassool, 1999; Renshaw et al., 2010). E-mail is a big part of the virtual campuses and is often used before, during, and after sessions (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). This aids individuals in exchanging information and or point them to the right direction that would be useful in increasing and understanding various methods available to them via documents and online sources (Aragon, 2003; Aras and Karakaya Polat, 2008; Association of American Colleges and Universities, 2006; Augar, Raitman, and Zhou, 2004). The next section will look at mobile learning.

8.3. MOBILE LEARNING

M-learning or mobile learning involves learning across multiple contexts, through social and content interactions, using personal electronic devices (Aggarwal, 2009; Agiresaasi, 2014; Ainscow et al., 2004; Alavi, 1994; Alavi and Leidner, 2001; Alevriadou, 2016). It is a form of distance education in which m-learners use mobile device educational technology at their convenient time (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). M-learning technologies include handheld computers, MP3 players, notebooks, mobile phones and tablets (Liu,

2009; Liv, 2004; Lorenzo, 2008; Mahoney and Hanrahan, 2011; Mason, 1998; Mattheos et al., 2008; McInnerney and Roberts, 2004). This type of pedagogy focuses on the mobility of the learner, interacting with portable technologies (Times Higher Education, 2016; Tsai, 2015; Tu, 2001, 2002; Tu and McIsaac, 2002; Ueno et al., 2017; UK Council for International Student Affairs, 2015). Using mobile tools for creating learning aids and materials becomes an important part of informal learning (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Figure 8.3 is a representation of the mobile learning experience.

M-learning is convenient in that it is accessible from virtually anywhere (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). Sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). This highly active process has proven to increase exam scores from the 50th to the 70th percentage, and cut the dropout rate in technical fields by 22% (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). M-learning also brings strong portability by replacing books and notes with small devices, filled with tailored learning contents (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013).

Figure 8.3: The mobile learning experience.

Source: XPLO e-Learning.

M-learning has the added benefit of being cost-effective, as the price of digital content on tablets is falling sharply compared to the traditional media including books, CD, and DVD (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). One digital textbook, for instance, costs one-third to half the price of a paper textbook (AFD, 2012), with zero marginal cost (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). The next section considers the implementation of instructional simulation.

8.4. INSTRUCTIONAL SIMULATION

An instructional simulation, also called an educational simulation, is a simulation of some type of reality, system or environment (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). It also includes instructional elements that help a learner explore, navigate or obtain more information about that system or environment that cannot generally be acquired from mere experimentation (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). Instructional simulations are typically goal oriented and focus learners on specific facts, concepts, or applications of the system or environment (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). Today, most universities make lifelong learning possible by offering a virtual learning environment or VLE (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014).

Not only can users access learning at different times in their lives; but they can also immerse themselves in learning without physically moving to a learning facility (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Alternatively, they can also interact face to face with an instructor in real-time (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). Such VLEs vary widely in interactivity and scope (Allen and Seaman, 2010; Allender, Cowburn, and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). For example, there are virtual classes, virtual labs, virtual programs, virtual library, virtual training, and the like (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015;

Hansen, 2012; Hanushek and Woessmann, 2010). Figure 8.4 demonstrates certain elements of instructional simulation.

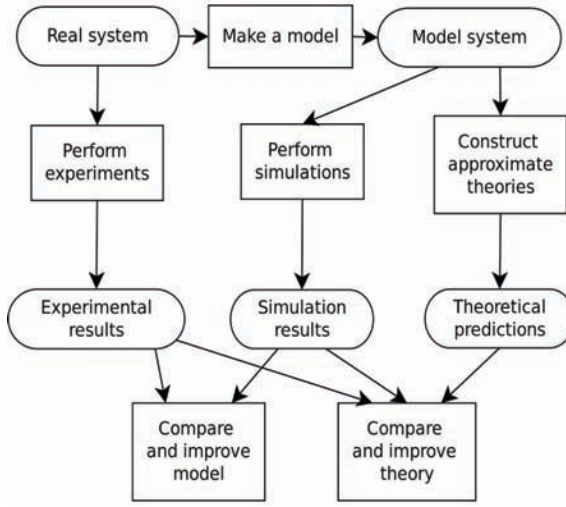

Figure 8.4: Instructional simulation elements.

Source: Wikipedia.

Simulations of one form or another have been used since the early 1900s as a method for training or training (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). The United States Defense Modeling and Simulation Coordination Office identifies three main types of simulation including live, virtual, and constructive (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). Live (live-action) and virtual simulations are primarily used for training purposes, whereas a constructive simulation is used to view or predict outcomes like wargaming or stock market behavior (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). Each of these types is based on some reality and is intended to provide the user with a pseudo-experience without the danger, expense, or complexity of real-life (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

While simulations are used for learning and training purposes, some experts suggest that simulations in and of themselves are not instructional

(Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Rather, a simulation only becomes instructional when instructional elements are included that help expose the learner to key parts or concepts of the system or environment (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). The simulator may be used for training purposes, but it requires an instructor or some other external element to identify key learning aspects of the system to the learner (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). In education, simulations have had their use under a number of different names (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016).

Researchers have defined simulations as interactions between people such as role-playing (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). Others suggest that experiential learning activities like those found in team training or ropes courses are also simulations because they replicate the human decision-making processes groups may display, albeit in a very different environment (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014). These can be considered instructional simulations because the effective use of these simulation types include using instructional elements to help learners focus on key behaviors, concepts or principles (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013).

With the ever-decreasing cost of computing tools, virtual, and constructive simulation are being used more and more (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Simulation is used more and more in e-learning environments because of improved Web-authoring tools and an increasing demand for performance-based training (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). As a result, more non-technical personnel are involved designing simulation, a field dominated by engineers and computer scientists (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013). This book will close with a segment on LMSs.

8.5. LEARNING MANAGEMENT SYSTEMS (LMSS)

A LMS is a software application for the administration, documentation, tracking, reporting, automation, and delivery of educational courses, training programs, or learning and development programs (Hutchinson, 2007; Hyland, 2015; International Educational Exchange, 2018; Jaffer, Ng'ambi, and Czerniewicz, 2007). The LMS concept emerged directly from e-Learning (Sawiuk, Taylor, and Groom, 2018; Schmidt et al., 2015; Seaman, Allen, and Seaman, 2018; Sener, 2010; Shankar, Smith, and Rangaswamy, 2003). Although the first LMS appeared in the higher education sector, the majority of the LMSs today focus on the corporate market (Dziuban et al., 2016; Eison, 2009; Ellison, Heino, and Gibbs, 2006; Englert and Seiler, 2020; Extremera, Ruiz-Juan, and Granero-Gallegos, 2016). LMSs make up the largest segment of the learning system market. The first introduction of the LMS was in the late 1990s (Rienties et al., 2012; Robinson, 2020; Röling and Jiggins, 1994; Ryan and Deci, 2000; Salovey, 2020; Saunders, Thornhill, and Lewis, 2009). Figure 8.5 highlights some elements of a LMS.

Figure 8.5: Elements of learning management systems.

Source: Fingent.

LMSs were designed to identify training and learning gaps, utilizing analytical data and reporting (Grieve et al., 2013; Grossman and Grossman, 1994; Gunawan et al., 2017; Gwinner, 2015; Hansen, 2012; Hanushek and Woessmann, 2010). LMSs are focused on online learning delivery but support a range of uses, acting as a platform for online content, including courses, both asynchronous based and synchronous based (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019). An LMS may offer classroom management for instructor-led training or a flipped classroom, used in higher education, but not in the corporate space (Allen and Seaman, 2010; Allender, Cowburn,

and Foster, 2006; Anderson, 2004; Anderson and Dron, 2011; Aradau, 2004). Modern LMSs include intelligent algorithms to make automated recommendations for courses based on a user's skill profile as well as extract meta-data from learning materials in order to make such recommendations even more accurate (Spencer, 2014; Stacey, 1999; Stepleman, Darcy, and Tracey, 2005; Sterling, 2001; Sternberg, 2003; Strauss, 2013).

An LMS delivers and manages all types of content, including video, courses, and documents (Austin and Beaulieu-Brossard, 2018; Bai et al., 2020; Bartram, 2008; Basit and McNamara, 2004; Bategeka and Okurut, 2006). In the education and higher education markets, an LMS will include a variety of functionality that is similar to corporate (Gil and Wakefield, 2015; Gillham, 2005; Gindis, 1999; Grant and Simmons, 2008; Greenland, 2011; Greenland and Moore, 2014). However, it will additionally have features such as rubrics, teacher, and instructor-facilitated learning, a discussion board, and often the use of a syllabus (UNESCO 2018; Universities UK 2014; Urgup and Aslan, 2015; Van Puyenbroeck and Maes, 2008; Vandeyar, 2015). A syllabus is rarely a feature in the corporate LMS, although courses may start with heading-level index to give learners an overview of topics covered (Bogo et al., 2014; Bolliger and Wasilik, 2009; Bowen, 2012; Brindley, Blaschke, and Walti, 2009; British Future and Universities UK 2014). There are several historical phases of distance education that preceded the development of the LMS (Mirza and Al-Abdulkareem, 2011; Muis et al., 2015; Mulhanga and Lima, 2018; National Council for Special Education, 2013). One of the earliest known categories is that of correspondence teaching (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019).

The first known document of correspondence teaching dates back to 1723 (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016). This was through the advertisement in the Boston Gazette of Caleb Phillips, professor of shorthand, offering teaching materials and tutorials (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). The first testimony of a bi-directional communication organized correspondence course comes from England in 1840 (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). This is when Isaac Pitman initiated a shorthand course, wherein he sent a passage of the Bible to students, who would send it back in full transcription (Brown, Broderick,

and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998).

The success of the course resulted in the foundation of the phonographic correspondence society in 1843 (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013). The pioneering milestone in distance language teaching was in 1856 by Charles Toussaint and Gustav Langenscheidt, who began the first European institution of distance learning (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). This is the first known instance of the use of materials for independent language study (Farhadi, 2019; Farnham and Horton, 1996; Fauci, Lane, and Redfield, 2020; Felder and Brent, 2005; Freed and McLaughlin, 2013). Correspondence institutions in the United States and across Europe were encouraged and fostered by the development in 1680 of the penny post service, which allowed the delivery of letters and parcels for a penny (Ngow, 2013; Niglas, 1999; Novak, Hoffman, and Yung, 2000; Nulty, 2008; Olanrewaju et al., 2015; Palvia, 2013).

Through LMS, teachers may create and integrate course materials, articulate learning goals, align content and assessments, track studying progress, and create customized test for students (Brown, Broderick, and Lee, 2007; Bruner, 1977; Buttner and Hasselhorn, 2011; Buzan, Waever, and de Wilde, 1998). LMS allows the communication of learning objectives, and organize learning timelines (Harrison and Agnew, 2016; Hasanah and Refanthira, 2019; Hau and Salili, 1993; Healy and Wairire, 2014; Heron, 2006). The key LMS leverage is that it delivers learning content and tools straight to learners (Jansson, Bukuluki, and Hojer, 2017; Johnson, Nolan, and Siegrist, 2006; Johnson, 2013; Jonsson, Kulaksiz, and Lithner, 2016). This means that it can also reach marginalized groups through special settings (Darley, Blankson, and Luethge, 2010; Datzberger, 2017; Davis and Deponio, 2014; Drisko, 2014; Durodie, 2016).

Such systems have built-in customizable features including assessment and tracking (Meadors, 2014; Meng et al., 2018; Merriam, 1998; Meyer and Wilson, 2011; Midgley, 2008; Milistetd et al., 2019). Hence, learners can see in real-time their progress and instructors can monitor and communicate the effectiveness of learning (Lane, 2018; Le, 2017; Lewis, 1996; Li, Chen, and Duanmu, 2010; Light and Harvey, 2017; Lillyman and Bennett, 2014). One of the most important features of LMS is trying to create a streamline communication between learners and instructors (Collins, 2005; Cooper

and Jacobs, 2011; Coursey et al., 2020; Creativity, Culture, and Education, 2010; Curtis and Lawson, 2001). Such systems, besides facilitating online learning, tracking learning progress, providing digital learning tools, manage communication, and maybe selling content, may be used to provide different communication features (Friedman, Khan Jr, and Howe, 2000; Gambini, 2006; Gardner, 1998; Gaytan and McEwen, 2007; Gensler, 2014).

The LMS may be used to create professional structured course content (Wolfinbarger and Gilly, 2001; Wood, 2004; Yang and Cornelious, 2005; Ye, Su, and Yan, 2009; Young, 2006; Zhao, McConnel, and Jiang, 2009; Ziguras, 2001). The teacher can add, text, images, tables, links, and text formatting, interactive tests, and slideshows (Casey and Evans, 2011; Cercone, 2008; Chang and Chen, 2008; Chare, 2013; Childers et al., 2001; Childress and Braswell, 2006). Moreover, you can create different types of users in hierarchies such as teachers, students, parents, visitors, and editors (Vasagar, 2011; Walsh, Ozaeta, and Wright, 2010; Walsh and Carson, 2019; Wang, 2009; Watkins and Cheng, 1995). LMS helps control which content a student can access, track studying progress and engage student with contact tools (Kentnor, 2015; Kingston and Forland, 2004; Knijnik, Spaaij, and Jeanes, 2019; Kotouaa, Ilkana, and Kilicb, 2015). Teachers can manage courses and modules, enroll students or set up self-enrollment, see reports on students and import students to their online classes (Weeden and Cornwell, 2020; Weiss, Gregoire, and Zhu, 2016; Wilke and Straits, 2001; Wilson and Stacey, 2004). With much of the integration of new resources being controlled by technical guidelines outlined by SCORM (sharable content object reference model), the process of integrating new features within multiple LMSs has become more efficient (Joshua, Nehemiah, and Ernest, 2015; Kabilan, Ahmad, and Abidin, 2010; Kaczmarczyk et al., 2013; Katsara and De Witte, 2019).

SUMMARY

This concluding chapter has highlighted some of the ways in which online educational technologies are being deployed in order to solve contemporary problems. In most cases, traditional approaches to education and its management are positively impacted by the introduction of technology. Nevertheless, there is still a belief that these technologies cannot completely replace human interaction.

Concluding Remarks

As recent history has shown us, there is nothing certain in the world apart from change. A few years back, a respiratory disease transmitted by air would have been the thing of conspiracy theories. Now, it is a reality, and everyone has been forced to adjust their ways of thinking and doing. The education sector cannot escape these realities since it operates within a context that is filled with events and narratives. In this case, the role of educational technology has come into focus primarily because it allows for teaching and learning to take place within the context of a largely socially distanced world. These events serve to show that the importance of online technologies is not about to wane. I hope you have enjoyed reading this book and will check out the other books in the series.

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Online Education as the Future:
Finding New ways to Teach and Learn in the New Age

What many of its critics deliberately or inadvertently ignored, was the fact that online education tended to attract those that were genuinely interested in learning. Because it requires a lot of effort, discipline, and sacrifice; it is hardly like that any disruptive student or lazy one for that matter will be very keen on online education. If you do not want to hand in your assignments, online education will make everything worse because there will be no tutor or mentor to see that you are not paying attention. There were some that started off with online education because they did not have the access to in-person classes that they would ideally prefer. Later on, when things looked up; these learners would try to "clean" their qualifications by attending an in-person institution.

All that was the norm until the advent of the COVID-19 crisis, a pandemic that hit the globe in 2020 and has infected both rich and poor equally. Suddenly, there were lockdowns and the traditional great institutions were looking for ways to retain their student numbers. Online education provided a solution since it was uniquely suited to an apparently captive audience that had been locked up in their homes and unable to attend traditional school. It became fashionable to offer online course as an alternative for those that were not able to come to class. Some started even questioning the need for international students to obtain visas to attend university since they could very well do it at home. Others were disquieted by the seeming mark-up bonanza that colleges were enjoying since online courses were infinitely cheaper to administer, yet the fees had not been proportionally reduced. There were also students that complained of loneliness and isolation.

This book comes at an opportune time because it addresses an education modality that has seen its fortunes transformed since the beginning of 2020. This decade is showing every sign of being dominated by online technologies. The education sector is not likely to be any different from other sectors that have had to make adjustments. The book therefore explores some of the broad themes that underpin this niche, including the opportunities for new pedagogies, curriculum reviews, health, and safety considerations, other practicalities, and the philosophical re-orientation of those that are in charge of the education sector. The book is relevant to anyone that has an interest in the education sector. It may also have relevance for those whose businesses and occupations rely on the internet. I hope you enjoy reading the book.

Dr. Emelyn Cereno Wagan obtained her Doctorate Degree major in Educational Management at Polytechnic University of the Philippines. Professor and lecturer at Laguna State Polytechnic University, Graduate Studies and Applied Research; Former English Professor at Thai Nguyen University, Vietnam. Former Campus Director, LSPU Extension Cabuyao Campus. Former Principal, LSPU Laboratory High School. She has written several Education Textbooks for college and senior high school students. Awarded by Asia Pacific Region: "Outstanding Trusted Premier Asian Achiever in Professional Higher Education 2018" ISO 9001-2008 Internal Quality Auditor. Model educator award 2019. Awarded Certificate of Commendation 2020 as volunteer for Taal Volcano eruption response, COVID 19 Pandemic response, Typhoon Deployment and other significant Humanitarian Assistance Disaster Response (HADR).

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