

Digital Transformation of Education for Quality Sustainability-Reference Based

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Abstract: Digital transformation (DX) is the adoption of digital technology by an organization to digitize non-digital products, services or operations. The goal for its implementation is to increase value through innovation, invention, customer experience or efficiency. Digital transformation entails considering how products, processes and organizations can be changed through the use of new, digital technologies. Digital transformation can be seen as a socio-technical programme.

Keywords: Digital Converter; Digital Transformation; Communication;

Introduction

Various pedagogical perspectives or learning theories may be considered in designing and interacting with educational technology. E-learning theory examines these approaches. These theoretical perspectives are grouped into three main theoretical schools or philosophical frameworks: behaviorism, cognitivism, and constructivism. This theoretical framework 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. Many psychologists used these results to develop theories of human learning, but modern educators generally see behaviorism as one aspect of a holistic synthesis. Teaching in behaviorism has been linked to training, emphasizing animal learning experiments. Since behaviorism consists of the view of teaching people how to do something with rewards and punishments, it is related to training people. B.F. Skinner wrote extensively on improvements in teaching based on his functional analysis of verbal behavior and wrote "The Technology of Teaching", an attempt to dispel the myths underlying contemporary education as well as promote his system he called programmed instruction. Ogden Lindsley developed a learning system, named Celeration, which was based on behavior analysis but substantially differed from Keller's and Skinner's models.

Cognitivism

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. 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. It refers to learning as "all processes by

which the sensory input is transformed, reduced, elaborated, stored, recovered, and used" by the human mind. The Atkinson-Shiffrin memory model and Baddeley's working memory model were established as theoretical frameworks. Computer science and information technology have had a major influence on cognitive science theory. 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. Another major influence on the field of cognitive science is Noam Chomsky. Today researchers are concentrating on topics like cognitive load, information processing, and media psychology. These theoretical perspectives influence instructional design.

There are two separate schools of cognitivism, and these are the cognitivist and social cognitivist. 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. These two schools, however, share the view that learning is more than a behavioral change but is rather a mental process used by the learner.

Constructivism

Educational psychologists distinguish between several types of constructivism: individual (or psychological) constructivism, such as Piaget's theory of cognitive development, and social constructivism. 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. Constructivist learning environments require students to use their prior knowledge and experiences to formulate new, related, and/or adaptive concepts in learning (Termos, 2012). Under this framework, the role of

the teacher becomes that of a facilitator, providing guidance so that learners can construct their own knowledge. Constructivist educators must make sure that the prior learning experiences are appropriate and related to the concepts being taught. Jonassen (1997) suggests "well-structured" learning environments are useful for novice learners and that "ill-structured" environments are only useful for more advanced learners. Educators utilizing a constructivist perspective may emphasize an active learning environment that 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. 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. LOGO, a programming language, embodied an attempt to integrate Piagetian ideas with computers and technology. Initially there were broad, hopeful claims, including "perhaps the most controversial claim" that it would "improve general problem-solving skills" across disciplines. However, LOGO programming skills did not consistently yield cognitive benefits. It was "not as concrete" as advocates claimed, it privileged "one form of reasoning over all others", and it was difficult to apply the thinking activity to non-LOGO-based activities. By the late 1980s, LOGO and other similar programming languages had lost their novelty and dominance and were gradually de-emphasized amid criticisms.

Practice

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. A variety of descriptive terms have been employed (somewhat inconsistently) to categorize the extent to which technology is used. For example, "hybrid learning" or "blended learning" may refer to classroom aids and laptops, or may refer to approaches in which traditional classroom time is reduced but not eliminated, and is replaced with some online learning. "Distributed learning" may describe either the e-learning component of a hybrid approach, or fully online distance learning environments.

Synchronous and asynchronous

E-learning may either be synchronous or asynchronous. Synchronous learning occurs in real-time, with all participants interacting at the same time. In contrast, asynchronous learning is self-paced and allows participants to engage in the

exchange of ideas or information without the dependency on other participants' involvement at the same time. Synchronous learning refers to exchanging ideas and information with one or more participants during the same period. Examples are face-to-face discussion, online real-time live teacher instruction and feedback, Skype conversations, and chat rooms or virtual classrooms where everyone is online and working collaboratively at the same time. Since students are working collaboratively, synchronized learning helps students become more open-minded because they have to actively listen and learn from their peers. Synchronized learning fosters online awareness and improves many students' writing skills. Asynchronous learning may use technologies such as learning management systems, email, blogs, wikis, and discussion boards, as well as web-supported textbooks, hypertext documents, audio video courses, and social networking using web 2.0. At the professional educational level, training may include virtual operating rooms. Asynchronous learning is beneficial for students who have health problems or who have childcare responsibilities. They have the opportunity to complete their work in a low-stress environment and within a more flexible time frame. In asynchronous online courses, students are allowed the freedom to complete work at their own pace. Being non-traditional students, they can manage their daily life and school and still have the social aspect. Asynchronous collaborations allow the student to reach out for help when needed and provide helpful guidance, depending on how long it takes them to complete the assignment. Many tools used for these courses are but are not limited to: videos, class discussions, and group projects. Through online courses, students can earn their diplomas faster, or repeat failed courses without being in a class with younger students. Students have access to various enrichment courses in online learning, still participate in college courses, internships, sports, or work, and still graduate with their classes.

Linear learning

Computer-based training (CBT) refers to self-paced learning activities delivered on a computer or handheld devices such as a tablet or smartphone. CBT initially delivered content via CD-ROM, and typically presented content linearly, much like reading an online book or manual. For this reason, CBT is often used to teach static processes, such as using software or completing mathematical equations. Computer-based training is conceptually similar to web-based training (WBT), which is delivered via Internet using a web browser. 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. Assessments are easily scored and recorded via online software, providing immediate end-user feedback and completion status. Users are often able to print completion records in the form of certificates. CBTs provide learning stimulus beyond traditional learning methodology from textbook, manual, or classroom-based instruction. CBTs can be a good alternative to printed learning materials since rich media, including videos or animations, can be embedded to enhance learning. However, CBTs pose some learning challenges. Typically, the creation of effective CBTs requires enormous resources. The software for developing CBTs is often more complex than a subject matter expert or teacher is able to use. 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.

Collaborative learning

Computer-supported collaborative learning (CSCL) uses instructional methods designed to encourage or require students to work together on learning tasks, allowing social learning. CSCL is similar in concept to the terminology, "e-learning 2.0" and "networked collaborative learning" (NCL). With Web 2.0 advances, sharing information between multiple people in a network has become much easier and use has increased. One of the main reasons for its usage states that it is "a breeding ground for creative and engaging educational endeavors." Learning takes place through conversations about content and grounded interaction about problems and actions. This collaborative learning differs from instruction in which the instructor is the principal source of knowledge and skills. The neologism "e-learning 1.0" refers to direct instruction used in early computer-based learning and training systems (CBL). 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. This phenomenon has been referred to as Long Tail Learning. Advocates of social learning claim that one of the best ways to learn something is to teach it to others. Social networks have been used to foster online learning communities around subjects as diverse as test preparation and language education. Mobile-assisted language learning (MALL) is the use of handheld computers or cell phones to assist in language learning.

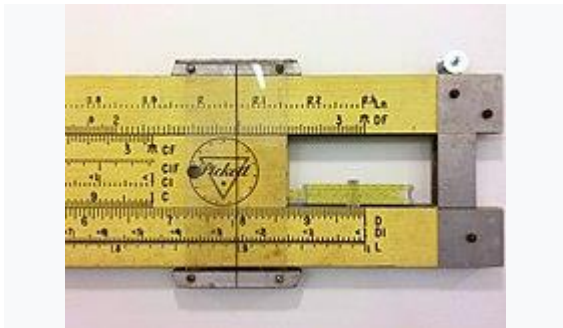
Collaborative apps allow students and teachers to interact while studying. Apps are designed after games, which provide a fun way to revise. When the experience is enjoyable, the students become more engaged. Games also usually come with a sense of progression, which can help keep students motivated and consistent while trying to improve. 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, enhancing educational outcomes and cultural integration. Further, many researchers distinguish between collaborative and cooperative approaches to group learning. For example, Roschelle and Teasley (1995) argue that "cooperation is accomplished by the division of labor among participants, as an activity where each person is responsible for a portion of the problem solving", in contrast with collaboration that involves the "mutual engagement of participants in a coordinated effort to solve the problem together." Social technology, and social media specifically, provides avenues for student learning that would not be available otherwise. For example, it provides ordinary students a chance to exist in the same room as, and share a dialogue with researchers, politicians, and activists. This is because it vaporizes the geographical barriers that would otherwise separate people. Simplified, social media gives students a reach that provides them with opportunities and conversations that allow them to grow as communicators. Social technologies like Twitter can provide students with an archive of free data that goes back multiple decades. Many classrooms and educators are already taking advantage of this free resource—for example, researchers and educators at the University of Central Florida in 2011 used Tweets posted relating to emergencies like Hurricane Irene as data points, in order to teach their students how to code data. Social media technologies also allow instructors the ability to show students how professional networks facilitate work on a technical level.

Flipped classroom

This is an instructional strategy in which computer-assisted teaching is integrated with classroom instruction. Students are given basic essential instruction, such as lectures, before class instead of during class. Instructional content is delivered outside of the classroom, often online. The out-of-class delivery includes streaming video, reading materials, online chats, and other resources. This frees up classroom time for teachers to more

actively engage with learners. Some research shows that flipped classroom can enhance students' studying efficiency because it can deliver rich educational resources to students at any time and any place.

Technologies



A 2.5 m teaching slide rule compared to a normal sized model

Educational media and tools can be used for:

- task structuring support: help with how to do a task (procedures and processes),
- access to knowledge bases (help user find information needed)
- alternate forms of knowledge representation (multiple representations of knowledge, e.g. video, audio, text, image, data)

Numerous types of physical technology are currently used: digital cameras, video cameras, interactive whiteboard tools, document cameras, electronic media, and LCD projectors. Combinations of these techniques include blogs, collaborative software, ePortfolios, and virtual classrooms. The current design of this type of application includes the evaluation through tools of cognitive analysis that allow to identify of which elements optimize the use of these platforms.

Audio and video

Preparation for training teachers on the subject of Wikipedia - Center for Educational Technology. 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. Videotelephony can connect with speakers and other experts. Interactive digital video games are being used at K-12 and higher education institutions. Radio offers a synchronous educational vehicle while streaming audio over the internet with webcasts and podcasts can be asynchronous. Classroom microphones, often wireless, can enable learners and educators to interact more clearly.

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. The presenter thus has the ability to show their ideas and flow of thoughts rather than simply explain them as simple text content. In combination with audio and video, the educator can mimic the one-on-one experience of the classroom. Learners have the ability to pause and rewind, to review at their own pace, something a classroom cannot always offer. Webcams and webcasting have enabled the creation of virtual classrooms and virtual learning environment. Webcams are also being used to counter plagiarism and other forms of academic dishonesty that might occur in an e-learning environment.

Computers, tablets, and mobile devices

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. With recent developments in smartphone technology, the processing powers and storage capabilities of modern mobiles allow for advanced development and the use of apps. Many app developers and education experts have been exploring smartphone and tablet apps as a medium for collaborative learning. Computers and tablets enable learners and educators to access websites as well as applications. Many mobile devices support m-learning. Mobile devices such as clickers and smartphones can be used for interactive audience response feedback. Mobile learning can provide performance support for checking the time, setting reminders, retrieving worksheets, and instruction manuals. 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. Computers in the classroom have been shown to increase rates of engagement and interest when computers and smart devices are utilized educationally in classrooms.

Collaborative and social learning

Group webpages, blogs, wikis, and Twitter allow learners and educators to post thoughts, ideas, and comments on a website in an interactive learning environment. Social networking sites are virtual communities for people interested in a particular subject to communicate by voice, chat, instant message, video conference, or blogs. 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. Social networking encourages collaboration and engagement and can

be a motivational tool for self-efficacy amongst students.

Whiteboards



Combination whiteboard and bulletin board

There are three types of whiteboards. The initial whiteboards, analogous to blackboards, date from the late 1950s. The term whiteboard is also used metaphorically to refer to virtual whiteboards in which computer software applications simulate whiteboards by allowing writing or drawing. This is a common feature of groupware for virtual meetings, collaboration, and instant messaging. Interactive whiteboards allow learners and instructors to write on the touch screen. The screen markup can be on either a blank whiteboard or any computer screen content. Depending on permission settings, this visual learning can be interactive and participatory, including writing and manipulating images on the interactive whiteboard.

Virtual classroom

A virtual learning environment (VLE), also known as a learning platform, simulates a virtual classroom or meetings by simultaneously mixing several communication technologies. Web conferencing software enables students and instructors to communicate with each other via webcam, microphone, and real-time chatting in a group setting. Participants can raise their hands, answer polls, or take tests. Students can whiteboard and screencast when given rights by the instructor, who sets permission levels for text notes, microphone rights, and mouse control. A virtual classroom provides an opportunity for students to receive direct instruction from a qualified teacher in an interactive environment. Learners can have direct and immediate access to their instructor for instant feedback and direction. 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. Besides, the virtual classroom provides a social learning environment that replicates the traditional "brick and mortar" classroom. Most virtual classroom applications

provide a recording feature. Each class is recorded and stored on a server, which allows for instant playback of any class over the course of the school year. This can be extremely useful for students to retrieve missed material or review concepts for an upcoming exam. Parents and auditors have the conceptual ability to monitor any classroom to ensure that they are satisfied with the education the learner is receiving. In higher education especially, a virtual learning environment (VLE) is sometimes combined with a management information system (MIS) to create a managed learning environment, in which all aspects of a course are handled through a consistent user interface throughout the institution. Physical universities and newer online-only colleges offer to select academic degrees and certificate programs via the Internet. Some programs require students to attend some campus classes or orientations, but many are delivered completely online. Several universities offer online student support services, such as online advising and registration, e-counseling, online textbook purchases, student governments, and student newspapers. Due to the COVID-19 pandemic, many schools have been forced to move online. As of April 2020, an estimated 90% of high-income countries are offering online learning, with only 25% of low-income countries offering the same.

Augmented reality

Augmented reality (AR) provides students and teachers with the opportunity to create layers of digital information, including both virtual worlds and real-world elements, to interact in real-time. AR technology plays an important role in the future of the classroom where human / AI co-orchestration takes place seamlessly. Students would switch between individual and collaborative learning dynamically, based on their own learning pace, while teachers, with the help of AR, monitor the classroom and provide necessary interventions in cases where computer systems are not yet designed to handle. In this vision, the technology's role is to enhance, rather than replace, human teachers' capabilities.

Learning management system

A learning management system (LMS) is software used for delivering, tracking, and managing training and education. It tracks data about attendance, time on task, and student progress. Educators can post announcements, grade assignments, check on course activities, and participate in class discussions. Students can submit their work, read and respond to discussion questions, and take quizzes. An LMS may allow teachers, administrators, and students, and permitted additional parties (such as parents, if

appropriate) to track various metrics. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration. The creation and maintenance of comprehensive learning content require substantial initial and ongoing investments in human labor. Effective translation into other languages and cultural contexts requires even more investment by knowledgeable personnel. Internet-based learning management systems include Canvas, Blackboard Inc. and Moodle. These types of LMS allow educators to run a learning system partially or fully online, asynchronously or synchronously. Learning Management Systems also offers a non-linear presentation of content and curricular goals, giving students the choice of pace and order of information learned. Blackboard can be used for K-12 education, Higher Education, Business, and Government collaboration. Moodle is a free-to-download Open Source Course Management System that provides blended learning opportunities as well as platforms for distance learning courses.

Learning content management system

A learning content management system (LCMS) is software for author content (courses, reusable content objects). An LCMS may be solely dedicated to producing and publishing content that is hosted on an LMS, or it can host the content itself. The Aviation Industry Computer-Based Training Committee (AICC) specification provides support for content that is hosted separately from the LMS. A recent trend in LCMSs is to address this issue through crowdsourcing. Computer-aided assessment (e-assessment) ranges from automated multiple-choice tests to more sophisticated systems. With some systems, feedback can be geared towards a student's specific mistakes, or the computer can navigate the student through a series of questions adapting to what the student appears to have learned or not learned. Formative assessment sifts out the incorrect answers, and these questions are then explained by the teacher. The learner then practices with slight variations of the sifted-out questions. The process is completed by summative assessment using a new set of questions that only cover the topics previously taught.

Training management system

A training management system or training resource management system is software designed to optimize instructor-led training management. Similar to an enterprise resource planning (ERP), it is a back office tool that aims at streamlining every aspect of the training process: planning (training plan and budget forecasting), logistics (scheduling

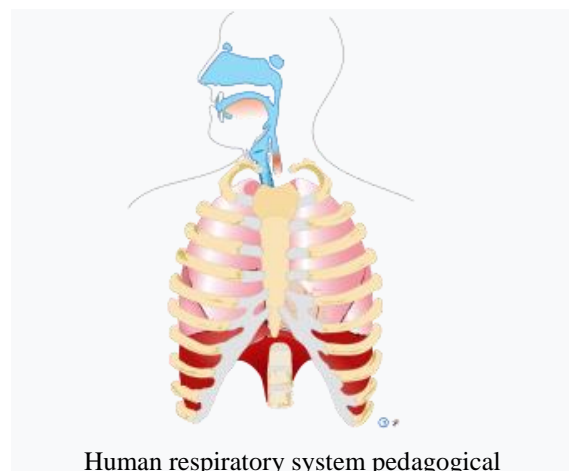
and resource management), financials (cost tracking, profitability), reporting, and sales for-profit training providers. A training management system can be used to schedule instructors, venues, and equipment through graphical agendas, optimize resource utilization, create a training plan and track remaining budgets, generate reports and share data between different teams. While training management systems focus on managing instructor-led training, they can complete an LMS. 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.

Standards and ecosystem

Content and design architecture issues include pedagogy and learning object re-use. One approach looks at five aspects:

- Fact – unique data (e.g. symbols for Excel formula, or the parts that make up a learning objective)
- Concept – a category that includes multiple examples (e.g. Excel formulas, or the various types/theories of instructional design)
- Process – a flow of events or activities (e.g. how a spreadsheet works, or the five phases in ADDIE)
- Procedure – step-by-step task (e.g. entering a formula into a spreadsheet or the steps that should be followed within a phase in ADDIE)
- Strategic principle – a task performed by adapting guidelines (e.g. doing a financial projection in a spreadsheet, or using a framework for designing learning environments)

Pedagogical elements



Pedagogical elements are defined as structures or units of educational material. They are the educational content that is to be delivered. These units are independent of format, meaning that although the unit may be delivered in various ways, the pedagogical structures themselves are **not** the textbook, web page, video conference, Podcast, lesson, assignment, multiple-choice question, quiz, discussion group or a case study, all of which are possible methods of delivery.

Learning objects standards

Much effort has been put into the technical reuse of electronically based teaching materials and, in particular, creating or re-using learning objects. These are self-contained units that are properly tagged with keywords, or other metadata, and often stored in an XML file format. Creating a course requires putting together a sequence of learning objects. There are both proprietary and open, non-commercial and commercial, peer-reviewed repositories of learning objects such as the Merlot repository. Sharable Content Object Reference Model (SCORM) is a collection of standards and specifications that applies to certain web-based e-learning. Other specifications, such as Schools Interoperability Framework, allow for the transporting of learning objects, or for categorizing metadata (LOM).

Artificial intelligence



Artificial intelligence (33661764490)

As artificial intelligence (AI) becomes more prominent in this age of big data, it has also been widely adopted in K-12 classrooms. One prominent class of AI-enhanced educational technology is intelligent tutoring systems (ITSs), designed to provide immediate and personalized feedback to students. 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. Over the years, a combination of cognitive science theories and data-driven techniques have greatly enhanced the capabilities of ITS, allowing it to model a wide range of students' characteristics, such as knowledge, affect, off-task behavior and wheel spinning. There is ample evidence that ITSs are highly effective in

helping students learn. ITSs can be used to keep students in the zone of proximal development (ZPD): the space wherein students may learn with guidance. Such systems can guide students through tasks slightly above their ability level. Recent works have also focused on developing AI-enhanced learning tools that support human teachers in coordinating classroom activities. 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. On the other hand, AI can share the workload and recommend the best course of action (e.g., by pointing out which students require the most help), but can only operate in the pre-specified domain and cannot handle tasks such as providing emotional support or remedial lessons to students in need. However, existing systems were designed under the assumption that students progress at the same pace. Understanding how to support teachers in a realistic, highly differentiated, self-paced classroom, remains an open research problem.

Preschool

Various forms of electronic media can be a feature of preschool life. Although parents report a positive experience, the impact of such use has not been systematically assessed. 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, such as the age-anticipated stages labeled by Swiss psychologist, Jean Piaget. Parameters, such as age-appropriateness, coherence with sought-after values, and concurrent entertainment and educational aspects, have been suggested for choosing media.

At the preschool level, technology can be introduced in several ways. At the most basic is the use of computers, tablets, and audio and video resources in classrooms. 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. Some options that are age-appropriate are video- or audio-recording of their creations, introducing them to the use of the internet through browsing age-appropriate websites, providing assistive technology to allow disabled children to participate with the rest of their peers, educational apps, electronic books, and educational videos. There are many free and paid educational website and apps that are directly targeting the educational needs of preschool children. These include Starfall, ABC mouse, PBS Kids Video, Teach me, and

Montessori crosswords. Educational technology in the form of electronic books offer preschool children the option to store and retrieve several books on one device, thus bringing together the traditional action of reading along with the use of educational technology. Educational technology is also thought to improve hand-eye coordination, language skills, visual attention, and motivation to complete educational tasks, and allows children to experience things they otherwise would not. There are several keys to making the most educational use of introducing technology at the preschool level: technology must be used appropriately, should allow access to learning opportunities, should include the interaction of parents and other adults with the preschool children, and should be developmentally appropriate. Allowing access to learning opportunities especially for allowing disabled children to have access to learning opportunities, giving bilingual children the opportunity to communicate and learn in more than one language, bringing in more information about STEM subjects, and bringing in images of diversity that may be lacking in the child's immediate environment. Coding is also becoming part of the early learning curriculum and preschool-aged children can benefit from experiences that teach coding skills even in a screen-free way. There are activities and games that teach hands-on coding skills that prepare students for the coding concepts they will encounter and use in the future.

Primary and secondary

E-learning is utilized by public K–12 schools in the United States as well as private schools. Some e-learning environments take place in a traditional classroom; others allow students to attend classes from home or other locations. There are several states that are utilizing virtual school platforms for e-learning across the country which continue to increase. Virtual school enables students to log into synchronous learning or asynchronous learning courses anywhere there is an internet connection. E-learning is increasingly being utilized by students who may not want to go to traditional brick-and-mortar schools due to severe allergies or other medical issues, fear of school violence and school bullying, and students whose parents would like to homeschool but do not feel qualified. Online schools create a haven for students to receive a quality education while almost completely avoiding these common problems. Online charter schools also often are not limited by location, income level, or class size in the way brick and mortar charter schools are. E-learning also has been rising as a supplement to the traditional classroom. Students with special talents or interests outside of the available curricula use e-learning to advance their

skills or exceed grade restrictions. Some online institutions connect students with instructors via web conference technology to form a digital classroom. National private schools are also available online. These provide the benefits of e-learning to students in states where charter online schools are not available. They also may allow students greater flexibility and exemption from state testing. Some of these schools are available at the high school level and offer college prep courses to students. Virtual education in K-12 schooling often refers to virtual schools, and in higher education to virtual universities. Virtual schools are "cybercharter schools" with innovative administrative models and course delivery technology. Education technology also seems to be an interesting method of engaging gifted youths that are under-stimulated in their current educational program. This can be achieved with after-school programs or even technologically-integrated curricula, for example: Virtual reality integrated courses (VRIC) can be developed for any course in order to give them such stimulation. 3D printing integrated courses (3dPIC) can also give youths the stimulation they need in their educational journey. Université de Montréal's Projet SEUR in collaboration with Collège Mont-Royal and La Variable are heavily developing this field.

Higher education

Online college course enrollment has seen a 29% increase in enrollment with nearly one-third of all college students, or an estimated 6.7 million students are currently enrolled in online classes. In 2009, 44% of post-secondary students in the USA were taking some or all of their courses online, which was projected to rise to 81% by 2014. Although a large proportion of for-profit higher education institutions now offer online classes, only about half of private, non-profit schools do so. Private institutions may become more involved with online presentations as the costs decrease. Properly trained staff must also be hired to work with students online. These staff members need to understand the content area, and also be highly trained in the use of the computer and Internet. Online education is rapidly increasing, and online doctoral programs have even developed at leading research universities. Although massive open online courses (MOOCs) may have limitations that preclude them from fully replacing college education, such programs have significantly expanded. MIT, Stanford and Princeton University offer classes to a global audience, but not for college credit. University-level programs, like edX founded by Massachusetts Institute of Technology and Harvard University, offer a wide range of

disciplines at no charge, while others permit students to audit a course at no charge but require a small fee for accreditation. MOOCs have not had a significant impact on higher education and declined after the initial expansion, but are expected to remain in some form. Lately, MOOCs are used by smaller universities to profile themselves with highly specialized courses for special-interest audiences, as for example in a course on technological privacy compliance. MOOCs have been observed to lose the majority of their initial course participants. In a study performed by Cornell and Stanford universities, student-drop-out rates from MOOCs have been attributed to student anonymity, the solitude of the learning experience, and to the lack of interaction with peers and with teachers. Effective student engagement measures that reduce drop-outs are forum interactions and virtual teacher or teaching assistant presence - measures which induce staff cost that grows with the number of participating students.

Teacher training

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. Teacher training aims for the effective integration of classroom technology. The evolving nature of technology may unsettle teachers, who may experience themselves as perpetual novices. Finding quality materials to support classroom objectives is often difficult. Random professional development days are inadequate. According to Jenkins, "Rather than dealing with each technology in isolation, we would do better to take an ecological approach, thinking about the interrelationship among different communication technologies, the cultural communities that grow up around them, and the activities they support." Jenkins also suggested that the traditional school curriculum guided teachers to train students to be autonomous problem solvers. However, today's workers are increasingly asked to work in teams, drawing on different sets of expertise, and collaborating to solve problems. 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". These twenty-first-century skills can be attained through the incorporation and engagement with technology. Changes in instruction and use of technology can also promote a higher level of learning among students with different types of intelligence.

Assessment

here are two distinct issues of assessment: the assessment of educational technology and assessment with technology. Assessments of educational technology have included the Follow Through project. Educational assessment with technology may be either formative assessment or summative assessment. Instructors use both types of assessments to understand student progress and learning in the classroom. Technology has helped teachers create better assessments to help understand where students who are having trouble with the material are having issues. 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. Technology has helped some teachers make their formative assessments better, particularly through the use of classroom response systems (CRS). A CRS is a tool in which the students each have a handheld device that partners up with the teacher's computer. The instructor then asks multiple choice or true or false questions and the students answer on their devices. Depending on the software used, the answers may then be shown on a graph so students and the teacher can see the percentage of students who gave each answer and the teacher can focus on what went wrong.

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. One huge benefit of tech-based testing is the option to give students immediate feedback on their answers. 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. Technology also allows for different kinds of summative assessment, such as digital presentations, videos, or anything else the teacher/students may come up with, which allows different learners to show what they learned more effectively. Teachers can also use technology to post graded assessments online so students to have a better idea of what a good project is. Electronic assessment uses information technology. 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. 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. E-marking allows markers to mark a scanned script or online response on a computer screen rather than on paper.

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. E-marking software is used by individual educational institutions and can also be rolled out to the participating schools of awarding exam organizations. 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. Ofqual reports that e-marking is the main type of marking used for general qualifications in the United Kingdom. In 2014, the Scottish Qualifications Authority (SQA) announced that most of the National 5 question papers would be e-marked. In June 2015, the Odisha state government in India announced that it planned to use e-marking for all Plus II papers from 2016.

Analytics

The importance of self-assessment through tools made available on educational technology platforms has been growing. 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. One of the unique tools for self-assessment made possible by education technology is Analytics. 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. Learning analytics is the field that focuses on analyzing and reporting data about students' activities in order to facilitate learning.

Expenditure

The five key sectors of the e-learning industry are consulting, content, technologies, services, and support. Worldwide, e-learning was estimated in 2000 to be over \$48 billion according to conservative estimates. Commercial growth has been brisk. In 2014, the worldwide commercial market activity was estimated at \$6 billion venture capital over the past five years, with self-paced learning generating \$35.6 billion in 2011. 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.

Careers

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

technology) of learning or instruction. In research, these professions typically require a graduate degree (Master's, Doctorate, PhD, or D.Phil.) 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. 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. The transformation of educational technology from a cottage industry to a profession is discussed by Shurville et al.

Teaching Excellence Framework

For information about other organisations or groups using the acronym TEF, The **Teaching Excellence and Student Outcomes Framework (TEF)** is a controversial government assessment of the quality of undergraduate teaching in universities and other higher education providers in England, which may be used from 2020 to determine whether state-funded providers are permitted to raise tuition fees. Higher education providers from elsewhere in the United Kingdom are allowed to opt-in, but the rating has no impact on their funding. The TEF rates universities as Gold, Silver or Bronze, in order of quality of teaching. The first results were published in June 2017. This was considered a "trial year" (even though the non-provisional ratings awarded are valid for 3 years) and is to be followed by a "lessons learned exercise" that will feed into the 2018 TEF and longer-term plans for subject-level ratings. In October 2017 the official title of the exercise was officially renamed from Teaching Excellence Framework to the Teaching Excellence and Student Outcomes Framework.

Accreditation

Accreditation is the independent, third-party evaluation of a conformity assessment body (such as certification body, inspection body or laboratory) against recognised standards, conveying formal demonstration of its impartiality and competence to carry out specific conformity assessment tasks (such as certification, inspection and testing). Accreditation bodies are established in many economies with the primary purpose of ensuring that conformity assessment bodies are subject to oversight by an authoritative body. Accreditation bodies, that have been peer evaluated as competent, sign regional and international arrangements to demonstrate their competence.

These accreditation bodies then assess and accredit conformity assessment bodies to the relevant standards. An authoritative body that performs accreditation is called an 'accreditation body'. The International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC) provide international recognitions to accreditation bodies. There are many internationally recognized accreditation bodies approved by the IAF and ILAC.

The Emirates International Accreditation Centre (EIAC) is the largest accreditation body in Middle East region, whereas in South Asia the Pakistan National Accreditation Council (PNAC) and National Accreditation Board for Testing and Calibration Laboratories (NABL), Quality Council of India (QCI) are the largest. In East Asia, the China National Accreditation Board is the largest, while the United Kingdom Accreditation Service (UKAS) is the largest in Europe. The National Association of Testing Authorities (NATA) and the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) being the largest in the Oceania region, with the South African National Accreditation System being the largest in Africa. For most of the accreditation schemes, international standards issued by the International Organization for Standardization (ISO) are used.

Accreditation processes are used in a wide variety of fields:

- Accredited investor
- Accredited in Public Relations
- Accredited registrar
- Construction
- Diplomatic accreditation
- Educational accreditation
 - Higher education accreditation
 - ACGME (USA)
 - List of recognized higher education accreditation organizations
 - List of unrecognized higher education accreditation organizations
 - Accreditation mill
 - List of unaccredited institutions of higher learning
 - Pre-tertiary education accreditation
- Email sender accreditation
- Food safety

- Global Food Safety Initiative
- Health & Safety Compliance (UK)
- Healthcare
 - American Association for Accreditation of Ambulatory Surgery Facilities
 - Accreditation Commission for Health Care
 - Electronic Healthcare Network Accreditation Commission
 - Emirates International Accreditation Centre (EIAC)
 - International healthcare accreditation
 - Commission on Accreditation of Rehabilitation Facilities
 - Hospital accreditation
 - Joint Commission (USA)
 - United Kingdom Accreditation Forum
- Information assurance
- Personal trainer accreditation
- Professional certification
- Systems engineering
- Translating and interpreting
 - National Accreditation Authority for Translators and Interpreters (Australia)
- Sustainability
 - Sustainable Forest management such as the Forest Stewardship Council (FSC)
 - Sustainable fishing such as the Marine Stewardship Council (MSC)
 - Sustainable aquaculture such as the Aquaculture Stewardship Council (ASC)
 - Sustainable tourism such as the Global Sustainable Tourism Council (GSTC)

zAccreditation standards

Many accreditation bodies, such as the UKAS, EIAC, EGAC, PNAC, IAS, NABCB operate according to processes developed by the ISO as specified in ISO/IEC 17011. Accredited entities in specific sectors must provide evidence to the accreditation body that they conform to other standards in the same series:

- ISO/IEC 17020: "General criteria for the operation of various types of bodies performing inspection" (2012)

- ISO/IEC 17021-1: "Conformity assessment. Requirements for bodies providing audit and certification of management systems" (2015)
- ISO/IEC 17024: "Conformity Assessment. General requirements for bodies operating certification of persons" (2012)
- ISO/IEC 17025: "General requirements for the competence of testing and calibration laboratories" (2017)

Community education

It is also known as **community-based education** or **community learning & development**, is an organization's programs to promote learning and social development work with individuals and groups in their communities using a range of formal and informal methods. A common defining feature is that programmes and activities are developed in dialogue with communities and participants. The purpose of community learning and development is to develop the capacity of individuals and groups of all ages through their actions, the capacity of communities, to improve their quality of life. Central to this is their ability to participate in democratic processes.

- Community education encompasses all those occupations and approaches that are concerned with running education and development programmes within local communities, rather than within educational institutions such as schools, colleges and universities. The latter is known as the formal education system, whereas community education is sometimes called informal education. It has long been critical of aspects of the formal education system for failing large sections of the population in all countries and had a particular concern for taking learning and development opportunities out to poorer areas, although it can be provided more broadly.
- There are a myriad of job titles and employers include public authorities and voluntary or non-governmental organisations, funded by the state and by independent grant making bodies. Schools, colleges and universities may also support community learning and development through outreach work within communities. The community schools movement has been a strong proponent of this since the sixties. Some universities and colleges have run outreach adult education programmes within local communities for decades.

Since the seventies the prefix word 'community' has also been adopted by several other occupations from youth workers and health workers to planners and architects, who work with more disadvantaged groups and communities and have been influenced by community education and community development approaches.

- Community educators have over many years developed a range of skills and approaches for working within local communities and in particular with disadvantaged people. These include less formal educational methods, community organising and group work skills. Since the nineteen sixties and seventies through the various anti poverty programmes in both developed and developing countries, practitioners have been influenced by structural analyses as to the causes of disadvantage and poverty i.e. inequalities in the distribution of wealth, income, land etc. and especially political power and the need to mobilise people power to effect social change. Thus the influence of such educators as Paulo Friere and his focus upon this work also being about politicising the poor.
- In the history of community education and community learning and development, the UK has played a significant role in hosting the two main international bodies representing community education and community development. These being the International Community Education Association, which was for many years based at the Community Education Development Centre based in Coventry UK. ICEA and CEDC have now closed, and the International Association for Community Development, which still has its HQ in Scotland. In the 1990s there was some thought as to whether these two bodies might merge. The term community learning and development has not taken off widely in other countries. Although community learning and development approaches are recognised internationally. These methods and approaches have been acknowledged as significant for local social, economic, cultural, environmental and political development by such organisations as the UN, WHO, OECD, World Bank, Council of Europe and EU.

Achievement through learning for adults

Raising standards of achievement in learning for adults through community-based lifelong learning opportunities incorporating the core skills of literacy, numeracy, communications, working with others, problem solving and information communications technology (ICT).

Achievement through learning for young people

Engaging with young people to facilitate their personal, social and educational development and enable them to gain a voice, influence and place in society.

Achievement through building community capacity

Building community capacity and influence by enabling people to develop the confidence, understanding and skills required to influence decision making and service delivery.

Conclusions

Education for Sustainable Development means including key sustainable development issues into teaching and learning; for example, climate change, disaster risk reduction, biodiversity, poverty reduction, and sustainable consumption. It also requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. Education for Sustainable Development consequently promotes competencies like critical thinking, imagining future scenarios and making decisions in a collaborative way. Education for Sustainable Development requires far-reaching changes in the way education is often practised today.

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