**Ludovika - University of Public Service**

**Faculty of Political Sciences and Public Administration**

# e-Learning in Continuing Education for Public Service: Comparison of Public Administration and Healthcare

Doctoral (PhD) Dissertation

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“If you can’t explain it simply,

you don’t understand it well enough”.

Albert Einstein

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## ABBREVIATIONS USED IN THE DISSERTATION

AI – artificial intelligence

ANCOVA - analysis of covariance

CPE - Continuing Pharmacy Education

CV - covariate

DPADM - Division of Public Administration and Development Management

DV – dependent variable

e-Learning – electronic learning

EMC - E-Learning Methodological Centre

EPAN - European Public Administration Network

IASIA - International Association of Schools and Institutes of Administration

ICT – internet and communications technology

IETCE - Institute of Executive Training and Continuing Education

IQR - interquartile range

IT – information technology

ITS – Intelligent Tutoring System

IV – independent variable

LSP - learning service providers

MOOC - Massive Open Online Course

NUPS – National University of Public Service

OECD - Organisation for Economic Co-operation and Development

PA – public administration

PDD - program-developing document

PSC - Program Steering Committee

SD – standard deviation

TNPA - Thematic Network in Public Administration

TOR - training output requirements

UN - United Nations

VLE – Virtual Learning Environment

VR – Virtual Reality

WWW – World Wide Web

# INTRODUCTION

In this dissertation, I investigate modern learning modes in continuing education among public administration (PA) servants and healthcare providers (pharmacists). The choice to explore innovative continuing education methods among professionals from such diverse backgrounds makes the research findings more universal and applicable not only to public servants and pharmacists but also to other professions where continuing education is necessary. Moreover, both public servants and pharmacists need to keep their professional knowledge up-to-date to perform their daily work tasks. It creates the need for continuing professional development.

According to Max Weber, education is crucial for attaining and maintaining social and economic status. He argues that every society accords education a prime role. In its unique way, every community creates links between social status, organisation of power, and education. Weber outlines the logic behind the system of examinations to screen or test "expertise", which then becomes a mechanism of sorting in bureaucratic systems of governance. His writings clarify the purpose that education, specifically higher education, must serve a society [Rao S. S., Singh S., 2018].

When considered from a policy or practical point of view, PA education is an essential factor in public administration's management and, specifically, the practicality of reformatory intentions of the government of the day. Comparative studies of PA education in the 2000s centred on several different scopes [Hajnal G., 2015]. Among which are the didactic systems used [Newswander L. K., Newswander C. B., 2012; Reichard C., 2002], issues related to quality assurance and accreditation [Geva-May I., Maslove A., 2007; Reichard C., 2010] and the "disciplinary composition, orientation and identity of the field" [Kickert W. J. M., Stillman R. J., 1999; Hajnal G., 2003; Bauer M. W., 2005; Geva-May I. et al., 2006; Geva-May I., Maslove A., 2007; Kickert W. J. M., 2007; Bouckaert G., 2008; Reichard C., Röber M., 2009; Nemec J. *et al*., 2012].

Compared to the United States, the nature of public administration being an academic area of study in Europe is more indistinct and variable, developing more radically in its temporal and geographical scopes, and composed to a greater extent of different cultures, institutions of learning or traditions. Joint initiatives of European public administration education institutions dedicated a considerable endeavour to diagnose the existing state of public administration education in Europe [Hajnal G., 2003]. The tenacious discrepancy in public administration teaching is in the disparity of academic houses that host public administration education. In Europe, institutes, schools and departments have a relatively diverse background, as seen in today's disciplinary embeddedness. PA is characteristically found taught in Law Schools or Sociology and Political Science in France. PA advanced into an independent field in the Netherlands, almost separated from Political Science; however, one frequently still finds PA contained in Political Science in faculties of Social Sciences and infrequently in faculties of Law. In Eastern and Central Europe, Public Administration is usually taught in Economics faculties, mirroring the central economic planning legacy of communism. Business schools are another home for PA programmes, particularly those with a management focus, as is usually the scenario in the UK [Brans M., Coenen L., 2016].

The divergence of PA programmes in Europe was experimentally demonstrated by Hajnal, whose quantitative investigation of "the relative disciplinary weight of curriculum components in 191 European PA programs" indicated that three programme identities exist: 1) "**legalistic type"** of PA education is indicated by law; 2) "**public type"** is characteristically fed by political and social sciences; 3) **"corporate type"** reveals a preponderance of components of economic and management curriculum. According to Hajnal, "some Continental European countries are characterised by a broad and significant political science component, typical of the public type. Nordic countries put a stronger emphasis on business administration. In most Southern European countries, and some post-communist countries, law predominates in the PA curricula" [Hajnal G., 2003].

The Thematic Network in Public Administration (TNPA) was formed within the European Higher Education Area. It was made up of 122 higher education institutions and associations that offered undergraduate and postgraduate programmes in Public Management or Public Administration, integrating the key universities active in the Public Administration field. The novel TNPA project, "The Europeanisation of Academic Programs in Public Administration 1997–2000", intended to identify the avant-garde in the learning of the European scope in Public Administration programmes and planned an approach to surmount deficiencies in higher Public Administration learning. The TNPA worked as a podium to generate and facilitate discussions about building a European scope in Public Administration programmes and expanding the field. The subsequent TNPA project pushed the European content of educational programmes in Public Administration further and created some tangible actions.

It drove and implemented measures to reinforce the European scope of programmes in Public Administration, for example, through the advancement of relative instructional modules. Also, it proactively advanced information dissemination and combined projects on subject matters that predicted several of the present arguments on the eminence of education at the undergraduate and Master stages, even at the PhD schooling level. In a more practical sense, the network supplied course designers with resources by spreading course content and new teaching approaches, including problem-based and case-based learning, as well as ICT teaching. The association European Public Administration Network (EPAN) was created to build a sustainable platform for the operations of the Thematic Network in Public Administration to unify TNPA's activities. A series of summer schools was one of EPAN's most visible products. The summer schools taught participants to employ problem-based learning, comparative case studies, and other techniques to make teaching and learning more effective and appealing. The first summer school was held at Leiden University in 2002 under "Europeanization, Institutional Analysis and Public Administration". "The second summer school was held in Bratislava in 2003 and focused on Public Policy Management from a comparative perspective, and the third summer school took place in Leuven in 2004. Its prime focus was on writing and teaching cases" [Brans M., Coenen L., 2016].

Public administration continuing education is one of several related activities universities, schools, or colleges may offer, sometimes in different units. Some universities provide PA continuing education that is **training centred** instead of degree centred, for instance, the one found in DPA and MPA degrees [Van Wart M., Holzer M., Kovacova A., 1999]. However, e-learning in continuing education in public administration has been researched scarcely qualitatively or quantitatively despite its significance to universities. The present investigative study considers the number and types of training, training partners, enrollees, personnel, and acceptance of e-learning courses among public servants and healthcare providers.

Many methodical meta-studies and reviews on the efficiency of e-learning are viewed from the perspective of language learning or healthcare. Such analyses principally include measurable research based on specific criteria, like "homogeneity of the respondents and predefined outcome measures" [Rosenberg H., Grad H. A., Matear D. W., 2003], transparency of statistical information [Grgurovic M., Chapelle C. A., Shelley M. C., 2013; Means B. *et al.*, 2013] or sample size [Veneri D., 2011]. Only one significant meta-review, which integrated quantitative and qualitative studies in an incorporative review examining "the outcome of distance learning for nursing education", was found [Patterson B. J., Krouse

A. M., Roy L., 2012]. The quantitative meta-reviews intended to consolidate the data from various quantitative research to show the effectiveness of e-learning. The above mixed-method meta-review covers the current state of research, explains how studies evaluate different outcomes and explores various elements of learning effectiveness [Noesgaard S. S., Ørngreen R., 2015]. This is analogous to the current thesis, which also applies "a mixed-method methodology" in an incorporative way.

Though connecting technology and education appears to be a natural endeavour at first look, it is far from being a seamless and progressive undertaking. Indeed, the history of educational technology reveals a lengthy and frequently challenging process of mutual adaptation and integration. In most situations, **technology delivers more challenges and lower productivity than expected at the beginning** [Lowyck J., 2008].

Internet technologies have changed the technological and economic landscape in using technology for learning. We will continue to fall short if we focus too much on the technology itself and not enough on how well it is being used. Finally, successful Internet-enabled learning or e-learning requires developing a plan that optimises technology within an organisational culture that is ready and eager to apply it [Rosenberg M. J., 2001].

According to Bronlund and others, "the route to using e-learning is not straightforward. High setup costs and time commitments to maintain quality are issues brought up in this respect" [Bronlund M., Kirk R., Basu A., 2011]. Inadequacy of standardisation of quality assurance has also been identified [Konstan J. A. *et al.*, 1997; Higgins S. A. K., Thorne D., 1998]. **e-Learning should meet the requirements for delivering knowledge and skills, as well as user acceptance,** to establish an underpinning for quality assurance [Williams K., Kear K., Rosewell J., 2012].

Educators documented the benefits of e-learning as including improved open access to education, place, and time flexibility. There are also limitations, namely **"high dropout rates, lack of management oversight, lack of attendee support, lack of sufficient interaction between a tutor and users"** [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

e-Learning is a suitable mode of education, which can occur anywhere and at anytime. It helps save extra expenses for participants (accommodation, travel) and providers (printing materials, renting the venue). On the other hand, campus-based education has advantages over e-learning, such as **interpersonal interaction, live meetings with the teacher, exact place**

**and time of training.** Consequently, to secure the level of the provided information, e-courses require standardisation and validation just like conventional courses. "It is not only the content of e-courses that requires reviewing by specialists but also the way they are designed and provided to attendees" [Nesterowicz K., 2014(b)].

For students and employees, e-learning vastly improves educational options. This potential, however, necessitates a certain amount of institutional preparedness in terms of human and infrastructural resources. Finding the best ways to implement e-learning into the educational process is one of the most critical tasks for universities and colleges [Frehywot S. *et al.*, 2013].

Key advantages of e-learning are reported such as "improved open access to education, including full degree programmes, or better integration for non-full-time students, particularly in continuing education" [Ahmad Z., 2010]. Furthermore, tools are provided to assist students in solving problems independently [Dalsgaard C., 2006].

**Some advantages of e-learning include:**

• differentiation of learning,

• reduction of cost

• flexibility of time,

• incorporated tools for assessment,

• multimedia forms,

• high interactivity.

The widespread use of technology, the quantity of information and knowledge, and the wide usage of multimedia applications make it difficult to present a practical and appealing e-learning model that incorporates all these components. Furthermore, quality assurance has become a significant challenge in the emerging e-learning environment. The degree of teacher/instructor skill and preparation in such a complex setting necessitates a new dynamic framework to assure educational quality [Al-Sharhan S., Al-Hunaiyyan A., 2014].

According to Rabai Ben Arfa and Rjaibi, “the increasing popularity of e-learning in continuing education requires investigation and evaluation of the quality and efficacy of this mode” [Rabai Ben Arfa L., Rjaibi N., 2011].

There is increasing empirical evidence that understanding the social component of learning (i.e., the importance of person-to-person and team interactions within the e-learning framework) is among the principal determinants for e-learning success. Peer learning’s social features can boost student motivation and engagement, strengthen social bonds, and provide more opportunities for students to get feedback on their progress [Morrison K., 2006]. Put in another way, teamwork or group, based on guidelines of adult education, encourages deeper learning via its inclination to promote higher-level critical thinking, creativity, collaboration, and innovation. As a joint effort is frequently employed in the professional perspective, this kind of work renders the skills that students need in a contemporary workplace [Durier-Copp M., Makani J., Kiceniuk D., 2015].

Students growing up in the digital era are exposed to a wide range of media [Geer R., Sweeney T., 2012; Craft A., 2012]. According to Huffington Post, “major high-tech companies such as Google, Verizon, and Microsoft have funded schools to provide them with the ability to teach their students through technology, in the hope that this would lead to improved student performance” [Huffington Post, 2011].

According to the journal “Chronicle for Higher Education”, universities report dropout rates for remote learners ranging from 20 to 50%. Furthermore, there is a lack of management supervision, student assistance, and adequate contact between teachers and users in many e-learning courses [Frankola K., 2001].

Zhang summarises in his work the advantages and disadvantages of e-learning in comparison to campus-based learning (Table 1) [Zhang D. *et al*., 2004].

Table 1. Traditional classroom learning vs e-learning [Zhang D. et al., 2004].

| | Traditional Classroom Learning | E-Learning |
|---|---|---|
| **Advantages** | • Immediate feedback<br>• Being familiar to both instructors and students<br>• Motivating students<br>• Cultivation of a social community | • Learner-centered and self-paced<br>• Time and location flexibility<br>• Cost-effective for learners<br>• Potentially available to global audience<br>• Unlimited access to knowledge<br>• Archival capability for knowledge reuse and sharing |
| **Disadvantages** | • Instructor-centered<br>• Time and location constraints<br>• More expensive to deliver | • Lack of immediate feedback in asynchronous e-learning<br>• Increased preparation time for the instructor<br>• Not comfortable to some people<br>• Potentially more frustration, anxiety, and confusion |

The challenges with e-learning implementation are connected to e-learning governance, e-content development, and issues experienced by both lecturers and students [Embi M.A., 2011]. Thus, we need to understand both the students' and teachers' perceptions of e-learning as they are among the system's users.

In 2019, the North American area dominated the worldwide e-learning sector with over 39% of the market. The market has grown due to rapid technological advancements, an increase in the number of Internet users in emerging countries, and government backing for the e-learning system. In developing countries, an increase in smartphone users, student uptake of online education, and vendors offering attractive subscription deals are all contributing to the e-learning market's rapid expansion. In the projected years 2020-2025, the Asia-Pacific region is expected to have the greatest growth rate of 15.2%. Training services dominated the market, accounting for over 70% of global e-learning revenue. Because of the increased number of new customers and the large potential market in Asia-Pacific, corporate training services are expected to rise rapidly. Figure 1 presents the global growth of the e-learning market [Kaushal A., 2020].

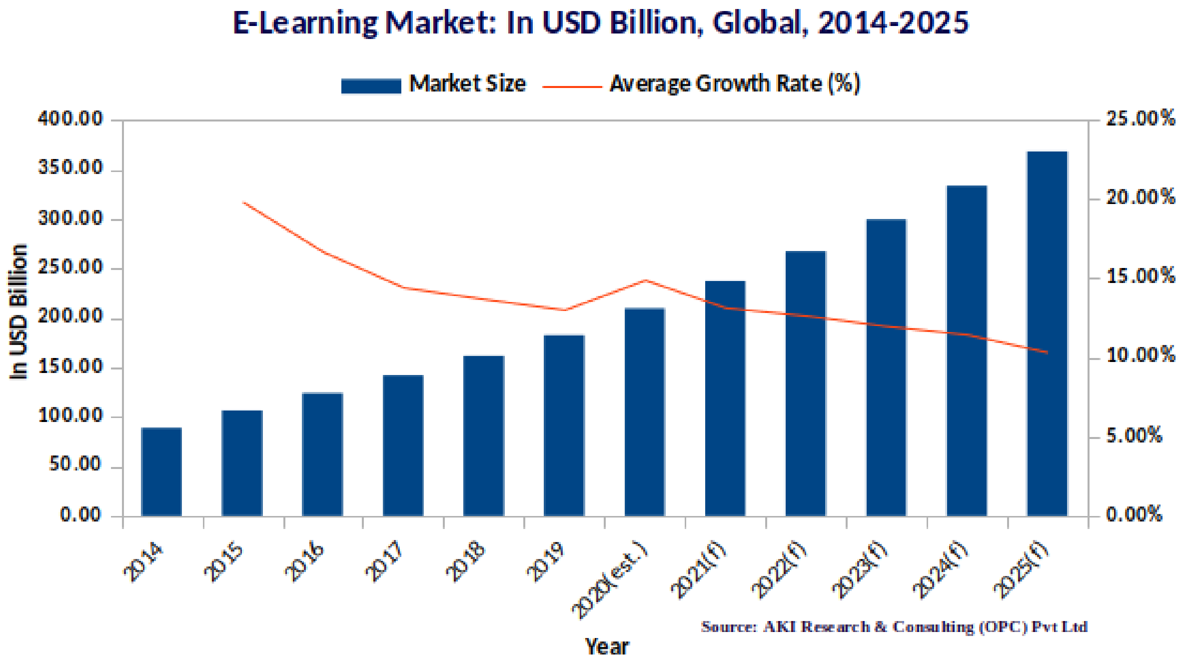



Figure 1. Global e-learning market growth, 2014-2025 [Kaushal A., 2020].

# 1. THE AIM OF THE STUDY AND RESEARCH QUESTIONS

The conveyance of knowledge and skills are essential goals of the educational process. Besides, the design of educational materials and their acceptance by users are significant factors for increasing educational efficiency. In this research, the e-learning courses were prepared for public administration servants and healthcare providers as part of their continuing education process. I have designed and carried out several observational and experimental studies in Hungary and Poland since 2008.

I posed four research questions:

1) **What are the success factors in designing e-learning courses with a multidisciplinary approach?**
2) **Is e-learning efficient in conveying knowledge compared to campus-based learning?**
3) **Is e-learning efficient in conveying skills compared to campus-based learning?**
4) **What is the users' acceptance of e-learning compared to campus-based learning?**

My research focused on **exploring success factors in designing e-courses by a multidisciplinary team, the efficiency of e-learning in conveying knowledge and skills, and the acceptance of e-learning among the users** (Figure 2).

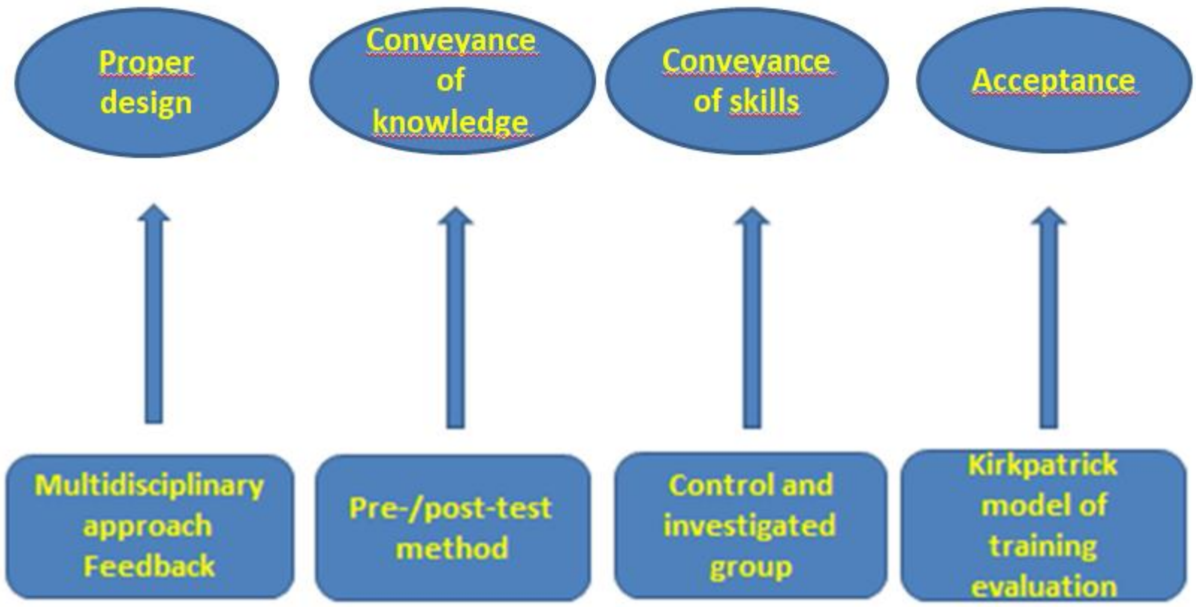



Figure 2. Visual representation of the research model.

An observational study was implemented, and feedback was gathered for exploring the success factors of e-learning design. Exclusively, there was a pre-/post-test method for the knowledge assessment, and for exploring the conveyance of skills, control and intervention groups were created. The Kirkpatrick model of training evaluation was implemented [Kirkpatrick D. L., Kirkpatrick J. D., 2006] to determine users' acceptance of e-learning courses.

The conveyance of knowledge was measured with the use of a **pre- and post-test study design.** The level of e-learning acceptance was evaluated using **questionnaires following the Kirkpatrick evaluation model** [Kirkpatrick D. L., Kirkpatrick J. D., 2006].

A pre- and post-test study design examines whether participants regress or improve in the course and then associates any such regression or improvement with the intervention [U.S. Department of Education, 2003]. In this research, the interventions were continuing education courses provided on-site (control group) or remotely (intervention group).

Among the known models for evaluating and analysing the results of educational and training programmes, the Kirkpatrick evaluation model is widely used (Figure 3). It considers any approach of training, both formal and informal, to establish propensity based on four levels of criteria [Kurt S., 2016]:

Level 1. **Reaction**: this measures the way participants react to the training (e.g., satisfaction).

Level 2. **Learning:** evaluates whether the learners comprehended the training (e.g., increase in experience, knowledge or skills).

Level 3. **Behaviour:** considers whether learners utilise what they learn at work (e.g., behavioural changes).

Level 4. **Results:** determine if the material had a positive impact on the organisation/business.

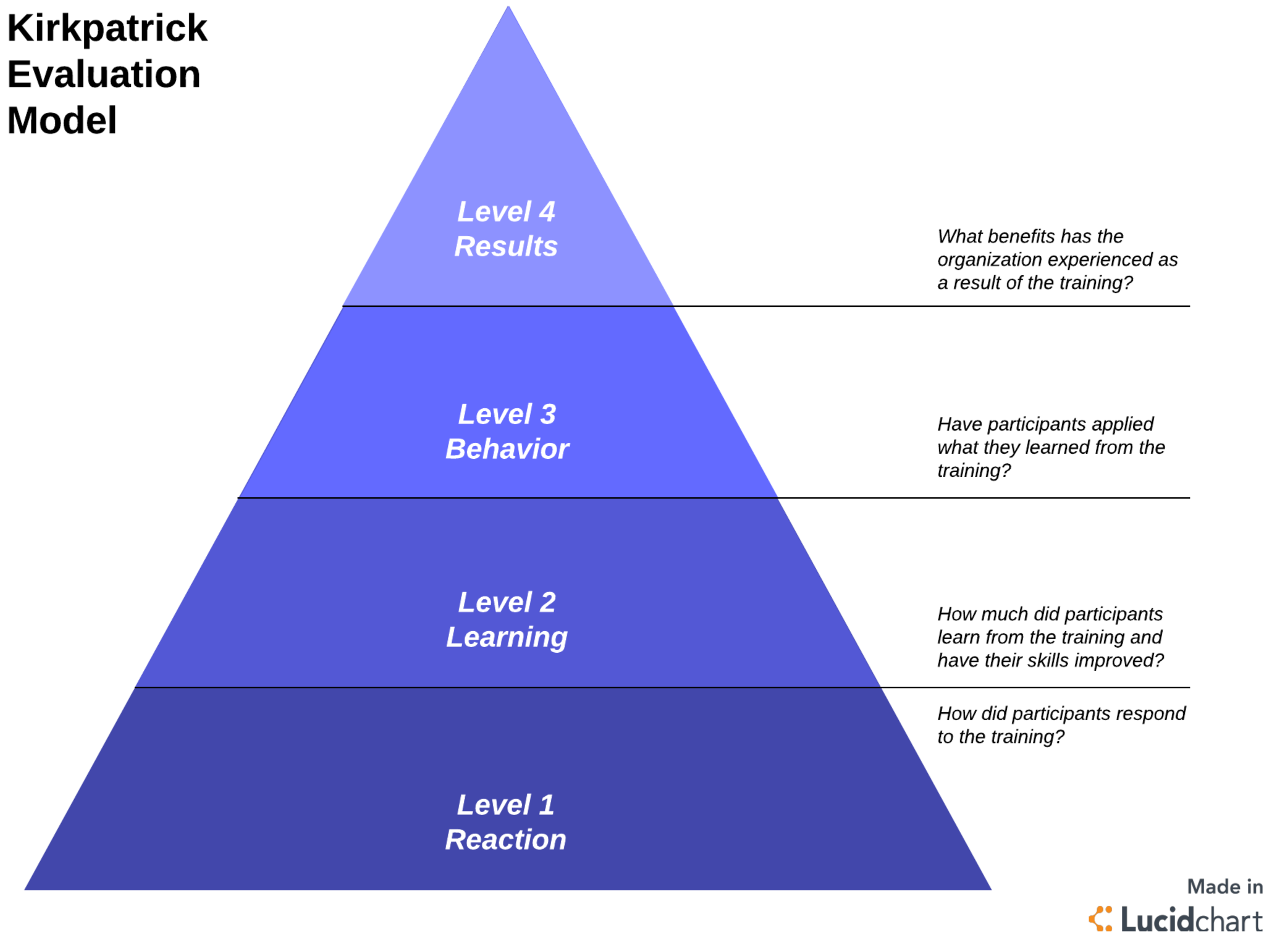



Figure 3. A visual representation of the Kirkpatrick evaluation model [Lucidchart Content Team, 2016].

# 2. E-LEARNING IN CONTINUING EDUCATION

## 2.1. Definition of e-Learning

Bansal states that "e-learning is an approach to facilitate and enhance learning through, and based on, both computer and communications technology. (…) may be used to suit distance learning through the use of Wide Area Networks, and may also be considered to be a form of flexible learning where just-in-time learning is possible" [Bansal H., 2009]. Others define e-learning as a pedagogy facilitated by digital technology [European Commission, 2000]. e-Learning at present, is defined as "the acquisition of knowledge and skills using electronic technologies such as computer- and Internet-based courseware and local and wide area networks" [Fatma S. F., 2013]. In several modern-day sectors, e-learning is frequently considered a novel type of learning that utilises the resources of the Internet to render often interactive, customised programmes and learning materials to various distant and local spheres of practice [Nicholson P., 2007].

According to Poór and others, "e-Learning is defined as follows: (1) in the wider sense: a process of training, transferring knowledge or studying which is aided by digital equipment (storage, retrieval, display, forwarding and feedback of content and study-aides); (2) more specifically: an open form and framework of training, accessible through a private or public network, which enables the efficient organisation of the training process for the user (young or adult), as well as appropriate communication and feedback between tutor and trainee, regardless of time or distance" [Poór J. *et al*., 2015].

"e-Learning should involve student-student, student-teacher, or teacher-teacher interaction. Participants of e-learning courses should be aware of the results of their education process; their knowledge should be evaluated throughout the course. Therefore, uploading materials on a website, like lectures or exercises, is still not real e-learning since it lacks this interactive component" [Nesterowicz K., 2009].

e-Learning is a ground-breaking approach to convey information for education purposes. Its function is to reinforce the skills, knowledge, and other learners' abilities [Siritongthaworn S.

*et al*., 2006]. The core of e-learning is rooted in the various mix and appearances of learning tools like videos, wikis, fora and e-books [Poór J. *et al*., 2015].

Figure 4 presents the critical performance determinants of e-learning - three scopes, namely system, personal and environmental.

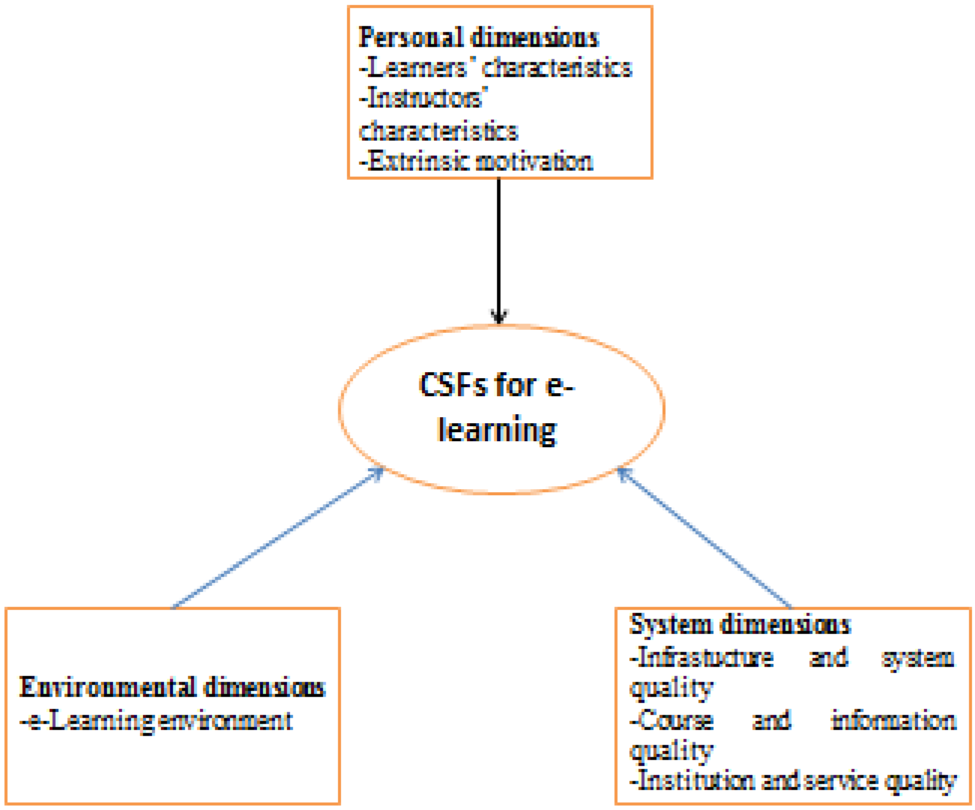



Figure 4. e-Learning's Critical Success Factors (CSF) [Bhuasiri W. et al., 2012].

From the communicative view, e-learning is divided into **asynchronous (offline)** and **synchronous (online)** communication. Offline communication is the activities that do not happen at the same time. Offline communication assists students to access the prospectus at any time according to their work and life condition. By using these resources, learners can get more time to take part in discussions, pose questions, give answers, complete assignments for reflection, and apply the learning in real-life situations. This kind of learning lets users enter the learning environment at a convenient place and time, access the educational content, and contact others. In e-learning, learners have contact with tutors, other learners, and/or the course content at the same time. One advantage of learners communicating online with the teacher, other learners, and other learning cases is that attendees feel a sense of community and belonging to a group, benefit from feedback from the teacher and other learners, and align with other learners to improve their learning. One of the asynchronous learning methods is a forum [Karanjam S., Yazdi F. K., Zarifsanaiey N., 2015].

Romiszowski summed up the learning forms characteristic of e-learning in a quadrant table (Table 2) [Romiszowski A. J., 2004].

Table 2. Learning activities characteristic of e-learning [Romiszowski A. J., 2004].

A structed definition of e-learning

| | INDIVIDUAL SELF-STUDY Computer-Based Instruction/Learning/Training | GROUP COLLABORATIVE Computer Mediated Communication |
|---|---|---|
| ONLINE STUDY Synchronous Communication (REAL-TIME) | Surfing the internet, accessing websites to obtain information or to learn (knowledge or skill) | Chat rooms with(out) video (IRC, Electronic Whiteboards) Audio/Video-conferencing |
| OFFLINE STUDY Asynchronous communication (FLEXI-TIME) | Using stand-alone courseware/Downloading materials from the Internet for later local study | Asynchronous communication by e-mail, discussion lists or a Learning Management System |

Romero presents in his blog an iconographic explaining which online educational content can be categorised as e-learning and which not (Figure 5) [Romero G., 2014].

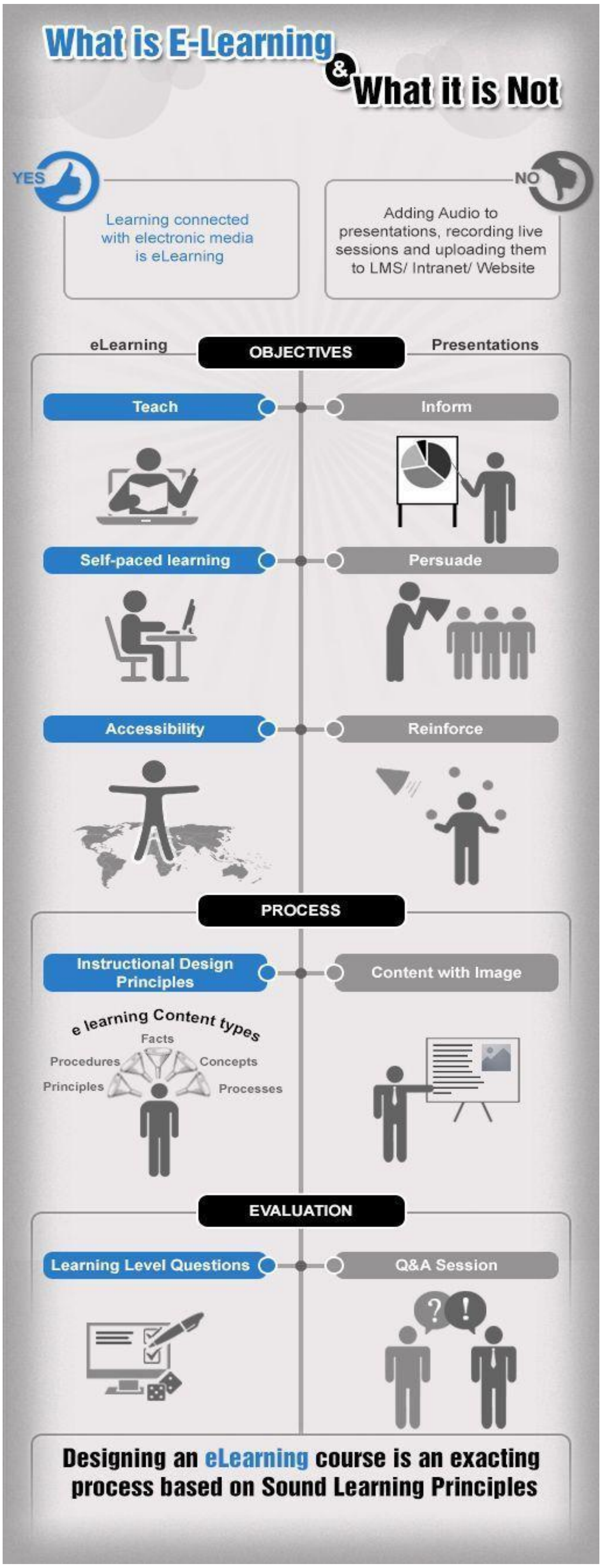



Figure 5. What is e-learning and what is not? [Romero G., 2014].

**Forum**

According to Williams, group cooperation has used a forum to search for information or solve problems happening in people's lives. Therefore, an online discussion is a representation of social context to support learning. Besides providing knowledge, this educational strategy promotes information storage and improves formal and informal learning environments. Exchanging information among learners in the forum enhances discussion, interaction, and finally, critical thinking. "Such virtual social communications cause the feeling of achieving knowledge in learners" [Williams I. M., 2014]. As per the study carried out by Mohammad and others, the comparison of online fora, contextual chats, and online learning interactions reported from students' views reflected learners' more extensive interest in an online forum (in contrast with two other methods) [Mohamad A. M., Yusof F. M., Aris B., 2014]. The study of Morrison and Seaton showed that using fora had beneficial effects on learning methods and gave grounds for facilitating searching, sharing information, and having access to tools for detailed education data analysis [Morrison D., Seaton J. X., 2014].

## 2.2 History of Educational Technology

Assisting individuals to study cheaper, faster, easier or more effective, can be traced back to the surfacing of very preliminary learning tools, like paintings on the cave walls [Nye D., 2006; Seel N. M., 2008]. Different kinds of abacus have been employed. Blackboards and writing slates have also been utilised for at least one thousand years [Biruni M. ibn A., Sachau E., 1910]. Pamphlets and books have assumed an important position in education from their introduction.

In the first years of the twentieth century, persons and, afterwards, allied professionals set that mission as a fundamental spotlight, consequently setting up educational technology as a field. With the advancement in radio broadcasting in the 1930s and subsequently television in the 1950s, these electronic media became systems to get in touch with vast audiences, within and outside school, providing education. The surge of interest in learning machines integrating programmed teaching founded on behaviourist psychology inundated the sector, bringing about an identity shift. The field's ideal learning grew from audio-visual technologies to all other technologies, including psychological ones. As in the 1980s, the focus moved to the framework of educational processes, particularly the dexterous use of teaching approaches, rejuvenated by discoveries from constructivist and cognitive points of view. As computers became more rampant in the 1990s, they became the delivery system of choice due to their interactive capabilities. After 1995, with the fast global growth of the World Wide Web, networked computers began to provide communication, storage, and processing services. The first decade of the 21st century saw educational technology increasingly focused on distant education, the most recent paradigmatic framework for the timeless aim of helping more people learn quicker, better, and more affordably [Molenda M., 2008].

The utilisation of media for education dates back to the first ten years of the 20th century [Saettler P., 1990] with the interpolation of educational films (the 1900s) as well as Sidney Pressey's mechanical teaching machines (the 1920s). The earliest "all multiple choice", large-scale evaluation was the Army Alpha. It was used to evaluate the intelligence and, more precisely, the capability of World War I military recruits. Films and other multimedia equipment, such as overhead multimedia projectors, were used to train soldiers on a larger scale during and after World War II. The idea of hypertext dates back to the Vannevar Bush explanation of memex in 1945. During the 1950s, slide projectors were employed mainly in settings of educational institutions.

In the 1960s, the University of Illinois pioneered a classroom system based on linked computer terminals that allowed students to access educational resources on a specific subject while listening to lectures recorded on remotely connected equipment such as a television or audio device [Woolley D. R., 2013]. The PLATO project at the University of Illinois started in 1961. It aimed to produce affordable education through interrelated cost-efficient terminals and a basic programming language for teaching, TUTOR [Saettler P., 1990].

The majority of the pioneer programmes were assignments with various branching measures, but a wide assortment of focus was built at the college level. Remote universities' terminals were linked to the central processor in a times-haring system, rising to hundreds of websites and thousands of hours of material accessible throughout the college programme. With continued software development, several ground-breaking display systems emerged, including a Visual Web Browser. More diverse teaching systems, including laboratory and discovery-oriented methods, became possible with more capable hardware and experience. Online message boards and fora, chat rooms, e-mail, remote screen sharing, multiplayer games, and instant messaging, resulting in the appearance of what was possibly the world's earliest online community, was pioneered by the PLATO system [Woolley D. R., 2013]. This system kept growing and developed right across the early 2000s, igniting the spreading of local Computer Assisted Instruction development and gaining a niche in occupational learning [Molenda M., 2008].

Stanford University psychology professors Patrick Suppes and Richard C. Atkinson carried out an experiment using computers to instruct elementary school students in the Palo Alto Unified School District in California in spelling and arithmetic through Teletypes in the mid-1960s [Suppes P., Jerman M., Groen G., 1966; Suppes P., 1971]. "Stanford's Education Program for Gifted Youth" is a product of those pioneer experiments. An influential book titled "Deschooling Society" in which Ivan Illich envisioned "learning webs" as a replica for people to network the education they required was published in 1971. The 1970s and 1980s witnessed considerable contributions in computer-based instruction by Murray Turoff and Starr Roxanne Hiltz at the New Jersey Institute of Technology [Hiltz S., 1990] and advancement at the University of Guelph in Canada [Mason R., Kaye A., 1989].

The Council for Educational Technology in the UK supported the application of educational technology, particularly administering the government's "National Development Programme in Computer Aided Learning" (1973-77) [Educational Technology, 2014] as well as the "Microelectronics Education Programme" (1980–86). As of the mid-1980s, it became possible to access course content at several college libraries. The education interaction in computer-based learning or computer-based training was between micro-world simulations or computer drills and the student. Digitised networking and communication in education began in the mid-1980s. Education institutions started to maximise the new medium by providing distance learning courses via computer networking for information. Pioneer online learning structures, founded on computer-based training/learning, often simulated autocratic styles of teaching. Therefore, the function of the online learning structure was to transfer knowledge, in contrast to later developed systems based on computer-supported concerted learning, which promoted the joint development of knowledge. Videoconferencing was a significant precursor to today's known educational technologies. Even more recently, videoconferencing has grown in popularity to get to over twenty thousand students throughout Canada and the United States in 2008–2009. The downsides of this kind of educational technology can be: videoconferencing needs the preparation of a sort of mini-television studio in the museum for transmission, space, therefore, becomes a challenge; quality of sound and image are frequently pixelated or grainy; and specialised apparatus is needed for both the participant as well as the provider [Crow W. B., Din H., 2009].

The University of British Columbia (where Web CT, now incorporated into Blackboard Inc., was first developed) and the Open University in Britain [Mason R., Kaye A., 1989] started a revolution in employing the Internet to provide education [Bates T., 2005], heavily online distance learning, an online discussion between students and utilising web-based training [Johnson H. M., 2007]. Professionals like Harasim lay profound focus on the application of learning networks [Harasim L. *et al*., 1995].

With the introduction of the World Wide Web in the 1990s, teachers started leveraging developing technologies, such as multi-object oriented sites, which are text-based online virtual reality systems, to construct course webpages with basic sets of instructions for their students [Srivastava E., Agarval N., 2013].

Publishers of textbooks maximised channels to utilise CD-ROM technology and the Internet to annexe conventional learning. Simon and Schuster were among the first to lead this field, initiating the New Media Group via its then Higher-Ed subsidiary, Prentice Hall. Richard Menta, the publisher of future MP3 Newswire, whose principal project was the Guest Lecture Series, was among the New Media Group's members. This was the first time when online video lectures were successfully delivered to universities. In December 1996, Harvard physics professor Eric Mazur gave the first lecture, "Peer Instruction" [Menta R., 2016].

**By 1994, the earliest online high school had been established.** In 1997, Graziadei explained the benchmark for assessing products and creating technology-based courses that encompass being replicable, portable, affordable, scalable, as well as having a high likelihood of long-term cost-effectiveness [Graziadei W. D. *et al.,* 1997].

Therefore, the 21$^{st}$ century opened with novel viewpoints towards e-learning, novel technological affordabilities, educational models, and mentality. A significant change became apparent, subtle, nevertheless ultimately intense. "A fundamental shift in the understanding of the very nature of learning and hence the definition, design, and delivery of education characterised the late 1990s and early 21$^{st}$ century, and this shift became civilisational and global as educators and learners worldwide adopted networked e-learning" [Harasim L., 2006].

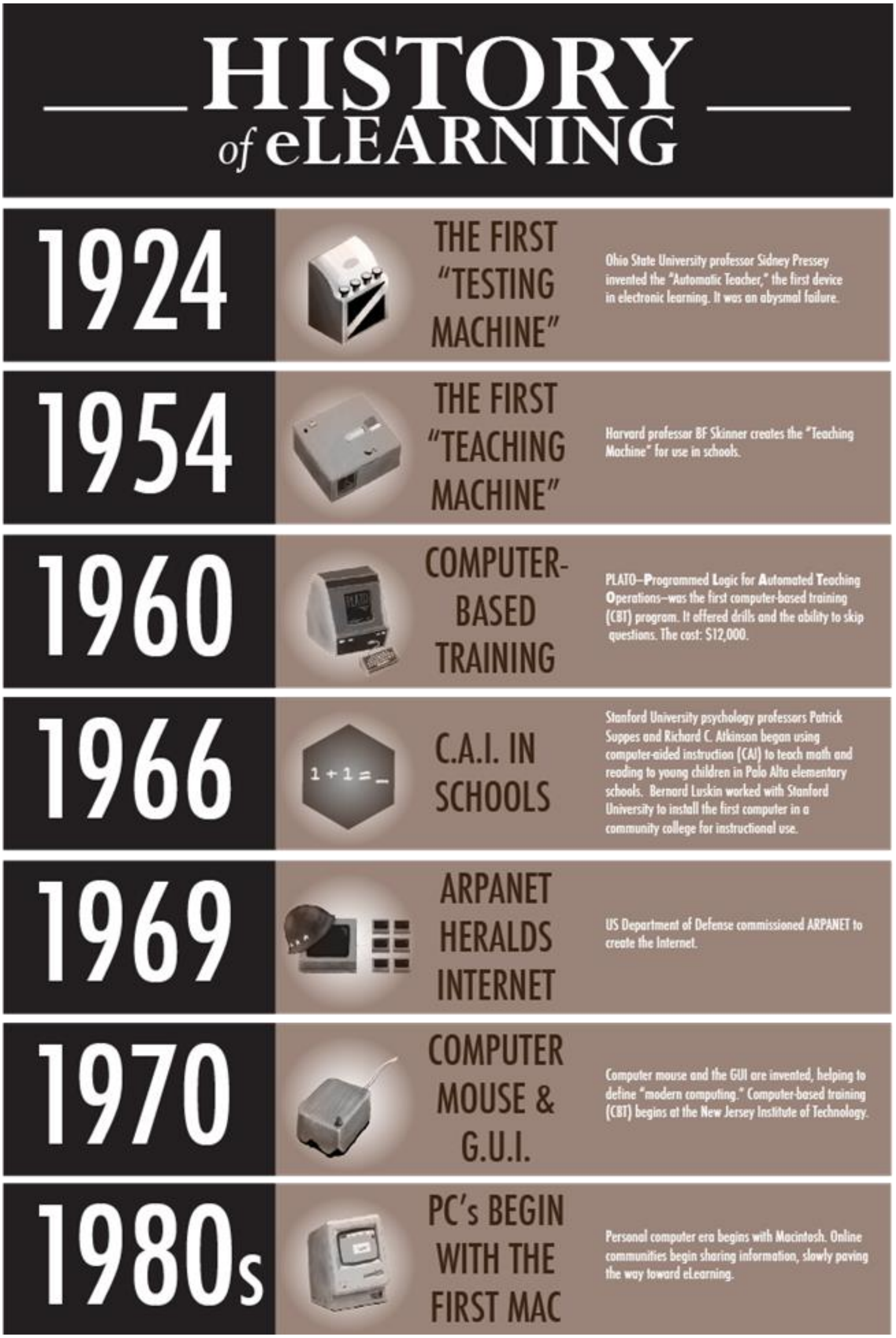
Following World War II, conventional teaching and learning, mostly in classrooms, were expected to be supported by information representation media like radio, television, slideshows, film, and video. The traditional school format hampered the flexible adaptation of these new media due to fixed time slots, predefined curricula, teacher resistance to change, and limited organisational flexibility, finances, and infrastructure [Lowyck J., 2008].

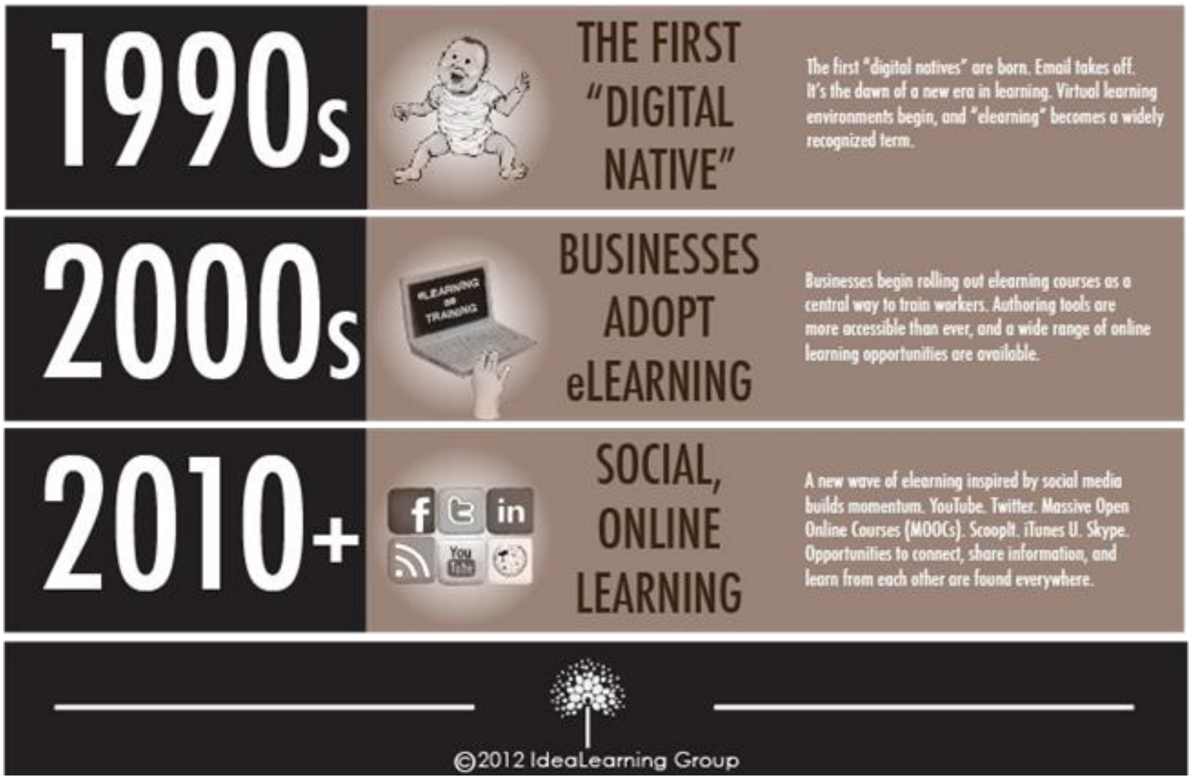
From 1970 onward, the growing use of computers gave rise to a twin debate about incorporating computers into learning settings. The society maintained that "youths had to be prepared to live in an information society, equipped with the computer skills necessary for driving on the information highway (though nowadays youths seem to outperform their teachers and parents in their use of digital technology)" on the one hand. Regarding strategy for innovation, most governments supposed equipping schools with computers would automatically enhance higher-order skill acquisition and learning processes. However, studies have revealed that computers only generate learning output if adequate support is accessible [Lowyck J., 2008].

Since the last decade of the 20$^{th}$ century, the communication features of networked computers have opened the closed position of personal computers. Computers are no longer considered personal computers or simply computing devices that process numbers. They are instruments that help people communicate with one another. These technologies can supplement, correct, or fine-tune information incorporated in instructional software or accessible on the Internet on the one hand, and generate new data and shared knowledge through computer interaction on the other [Lowyck J., 2008].

Gogos gave a brief history of e-learning in the form of an infographic (Table 3) [Gogos R., 2012].

Table 3. A brief history of e-learning, infographic [Gogos R., 2012].






Enhanced Internet capabilities made modern systems of interaction with webcams or multimedia possible. According to the National Center for Education Statistics, the number of K-12 students enrolled in online learning programmes increased by 65% between 2002 and 2005, owing to increased flexibility, ease of communication between teacher and student, and rapid lecture and assignment feedback [National Center for Education Statistics, 2006].

Research conducted by the U.S. Department of Education documented that approximately 66% of postsecondary public and private schools taking part in student financial aid programmes provided some remote learning courses during the 2006–2007 academic year, with 77% of enrolment in for-credit classes with an online component [Wiltshire-Bridle M., 2013]. In 2008, the Council of Europe passed a statement, approving the potential of e-learning to steer education and equality improvements throughout the European Union [Council of Europe, 2008].

## 2.3. Categories of e-Learning

e-Learning mediation can be grouped into **six categories** based on the technologies employed for the education activities. They include **m-learning, psychomotor skills trainer, online and local area network-based e-learning, digital game-based learning, virtual reality environments,** and **offline computer-based e-learning** [George P. P. *et al.*, 2014; Rasmussen K. *et al*., 2014].

In **offline computer-based e-learning**, the education activities are carried out via a laptop or personal computer (PC) without an Internet connection. The teaching delivery method tools can be carried out offline via USB memory stick, digital video disc or compact disc, also online via the network connection, considering that the "learning activities do not rely on this connection" [George P. P. *et al.*, 2014; Rasmussen K. *et al*., 2014]. Offline computer-based e-learning is usually used in secluded places with limited network access to surmount the challenge of accessing online e-learning. The research by Rasmussen *et al*. opined that "offline e-learning was equivalent to and might be better than traditional learning in terms of knowledge, skills, attitude, and satisfaction among the students" [Rasmussen K. *et al*., 2014]. It will, therefore, be helpful for the learning process to incorporate offline e-learning in the conventional education process.

In **online and local area network-based e-learning**, the education activities depend entirely on the Internet and intranet networks. The connection network engages transmission control protocol and the internet protocol to render the e-learning tools to the learners [George P. P. *et al*., 2014]. The availability of the Internet is among the key determinants of the successful execution of online e-learning [Goi C. L., Ng P. Y., 2009].

In **the psychomotor skills trainer**, e-learning is being employed to prepare good motor coordination techniques and skills in education, including learning the ideal methods of managing instruments or tools [George P. P. *et al.*, 2014]. The research by Cantarero-Villaneuva revealed that "e-learning technologies could be used as additional tools to improve students' acquirement of the manual skills for patient physical examination and diagnosis" [Cantarero-Villanueva I. *et al*., 2012].

An artificial or natural setting is created in the computer in a **virtual reality environment,** allowing the user to communicate with the outside environment [George P. P. *et al*., 2014].

The information is visualised in a three-dimensional form, and an interactive atmosphere is provided through the specific subject available to enhance the sensation of immersion into the virtual world. The virtual environment's capacity to accommodate numerous users simultaneously allows them to engage digitally and foster collaborative learning [Monahan T., McArdle G., Bertolotto M., 2008].

In **digital game-based learning**, the application for learning employs the principle of mechanics and games in non-game situations to support students to execute the given tasks and develop their passion, understanding, and attitude [George P. P. *et al*., 2014]. "In this type of e-learning intervention, self-initiated learning is developed, where the game developer used the users' enjoyment as a catalyst to stimulate the learning process. This is done to overcome the lack of users' initiatives to study when using other types of e-learning environments" [Fu F. L., Su R. C., Yu S. C., 2009].

**m-learning (mobile learning)** is the sixth category of e-learning. An e-learning intervention employs a mobile podium like a tablet or smart phone to give the learning materials [George P. P. *et al*., 2014]. According to the research carried out at Open University Malaysia, "m-learning in tertiary education is believed to be able to help students to manage their time to study more properly and motivate them to study" [Abas Z. W., Peng C. L., Mansor N., 2009]. Therefore, m-learning is advised to be employed as one of the aids for learning as it will provide the students with advantageous effects [Azhari F. A., Ming L. C., 2015].

## 2.4. Framework for e-Learning

"What does it take to provide flexible learning environments for learners worldwide"? Khan has been communicating with instructors, learners, trainers, administrators, technical and other support staff involved with e-learning in academic and corporate environments worldwide with this question since 1997. Khan studied essential issues in e-learning deliberated in specialised discussion fora and planned and taught online courses. Khan states that "e-learning represents a paradigm shift not only for learners but also for instructors, trainers, administrators, technical and other support staff and the institution. We (i.e., students, instructors and staff) are accustomed to the structure of a traditional educational system where instructor-led, face-to-face classes are the learning environment. e-Learning, on the other hand, is an innovative way of delivering instruction to diverse learners in an environment where students, instructors and support staff do not see each other. The format of such a learning environment is different from traditional classroom instruction. Traditional classroom-based instruction takes place in a closed system (the confines of a given classroom, school, textbook or field trip), whereas e-learning takes place in an open system (open and flexible space (…)). Learners in an open, flexible and distributed learning environment need immediate attention and feedback on their work to continue their learning. One needs to provide the best support systems, so they do not feel isolated and join the list of dropouts. As we are accustomed to teaching or learning in a closed system, the openness of e-learning is new to us. To create effective environments for diverse learners, however, we need to jump out of our closed system learning design mentality". Khan provided the e-Learning Framework to enable such a shift and confront many problems (Figure 6). Several elements contribute to developing an effective educational environment. Some of them are interconnected and interrelated [Khan B. H., 2010].

Khan clustered these factors into eight dimensions [Khan B. H., 2010]:

**1) evaluation,**

**2) ethical,**

**3) interface design,**

**4) institutional,**

**5) management,**

**6) pedagogical,**

**7) resource support,**

**8) technological.**

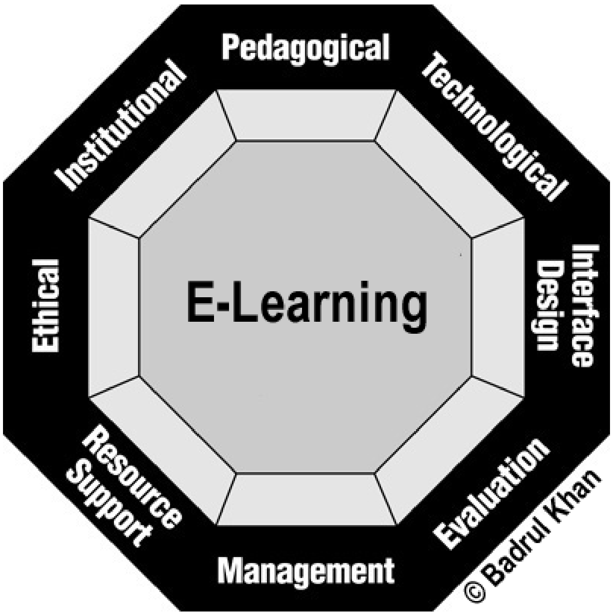



Figure 6. The e-Learning Framework [Khan B. H., 2010].

This framework aims to assist one to consider every facet of what one is doing during the design process of e-learning [Khan B. H., 2010]. Diverse issues in the eight scope of the framework were seen to be valuable in many studies that were done to reassess e-learning resources, tools and programmes [Dabbagh N. H., Bannan-Ritland B., Silc K., 2000; Gilbert P. K., 2000; Kao D., Tousignant W., Wiebe N., 2000; Khan B. H., 2007; Khan B. H., Smith H. L., 2007; Romiszowski A. J., 2004; Singh H., 2003; Chin K. L., Kon P. N., 2003; Kuchi R., Gardner R. Tipton R., 2003; Mello R., 2002; Barry B., 2002; Goodear L., 2001; Khan B. H., Waddill D., McDonald J., 2001; Khan B. H., Ealy D., 2001; El-Tigi M. A. and Khan B. H., 2001; Zhang J., Khan B. H., Gibbons A., Ni Y., 2001]. Every scope has many sub-dimensions. In turn, each sub-dimension comprises themes or elements that centre on a specific area of an e-learning environment. Every e-learning project is distinctive. A way to identify crucial issues is by putting each stakeholder category (like a learner, support staff, instructor, etc.) at the framework's core and then asking questions down the eight scopes of the e-learning setting. One can spot several crucial issues and provide answers to questions that can help develop a worthwhile e-learning environment for that specific group. One can produce an all-inclusive list of topics for an e-learning project by repeating the same process for other stakeholder groups. For instance, is the course susceptible to students from various time zones? This is an example of a question that e-learning designers can put in the geographic variance section of the ethical scope. The aim of asking several questions within each scope is to assist designers in thinking their projects through. As more and more schools globally offer e-learning, designers will know more about emerging issues in the eight scopes of e-learning. The e-Learning Framework applies to e-learning of any dimension. This scope indicates a range characterised by the degree to which teaching is rendered online and thus needs to be planned systematically. The given importance to each e-learning scope or sub-scope or series of e-learning tools differs with the dimension of the teaching. This range is explained with examples below to establish the scope and type of e-learning activities as well as the way they are linked to the different scopes of the framework. At the micro end of the continuum, e-learning activities and information resources may be built for face-to-face instruction in education and training environments (e.g., blended learning). For example, in a high school physics lesson, a teacher may employ Shockwave simulations to help the cognitive work of data analysis, idea visualisation, and model manipulation [ExploreLearning, 2015]. The teacher would need to plan actions that give perspective and details to this web-mediated, highly visual model. In a conventional course, the management and institutional scopes of the e-Learning Framework will much less matter than the learning strategies segment of the pedagogical scope, which gives the procedure for incorporating simulation into the programme. A more coherent plan is needed for the complete training or academic course further along the continuum, where activities, content, interaction, project work, assessment and tutorials must be given through the Internet. Petersons.com database offers links to many such courses that are entirely or principally distance-based [http://www.lifelonglearning.com]. Extra scopes of the e-Learning Framework will be functional in scheming such courses. Lastly, the e-Learning Framework can design entire distance learning programmes and virtual universities at the 'macro' end of the continuum without a face-to-face mode [Khan B. H., 2001].

"Are all sub-dimensions within the eight dimensions necessary for e-learning? Which ones do I need to address?" [Khan B. H., 2010]. It, again, depends on the dimension of your e-learning design. According to Khan, to design an e-learning course, it is essential to start with the institutional component of the e-Learning Framework and then look at other aspects for concerns that apply to a project. A complete preparedness evaluation should be done in this situation. However, some institutional sub-dimensions may not be necessary when creating a single e-learning course. It is challenging to develop open, adaptable, and dispersed e-learning systems for a worldwide audience. We should strive to fulfil the requirements of a wide range of students by asking critical questions along with the framework's eight aspects [Khan B. H., 2010].

## 2.5. e-Learning 1.0, 2.0 and 3.0

There are three main stages in the evolution of e-learning: 1.0, 2.0 and 3.0.

According to Kumar, **"e-Learning 1.0** uses a learning management system to create, design and manage courses, as well as supporting content delivery, user registration, monitoring and certification. The system's focus is on content and learning objects, with less consideration for the learning process. There is not much scope for communication and collaboration. Even though tools for collaboration are available, their application in learning is negligible**"** [Kumar R. A., 2009].

**e-Learning 2.0** is characterised by interactive courses. User contribution is not restricted to mailing lists and newsgroups. Social software transformed online learning. Web 2.0 gave birth to e-learning 2.0. The impact of emerging activities on the Web led to a new category of services, jointly called e-learning 2.0 [Kumar R. A., 2009].

Table 4 summarises the differences between e-learning 1.0 and 2.0.

Table 4. Basic differences between e-learning 1.0 and 2.0 [Sbihi B., Kadiri K. E., 2010].

| e-Learning 1.0 | e-Learning 2.0 |
|---|---|
| Platform LMS and LCMS | Tools Web 2.0 |
| Based on a teacher | Based on a learner |
| Teacher produces | Teacher validates |
| Learner is a spectator | Learner is a producer |
| Exchange with a class | Exchange with a community |

**e-Learning 3.0** is presently a term freely used in diverse discussion fora and blogs by researchers in education [Wheeler S., 2009; Walters S., 2010; Moore D., 2010]. The rise of cloud computing and the accessibility of new technologies such as collaborative intelligent filtering, expanded and trustworthy data storage capacity, better screen resolutions, multi-gesture devices, and the 3D touch user interface are bringing in the era of e-learning 3.0 [Hussain F., 2013]. e-Learning 3.0 is characterised by **the ever-present availability of educational resources with mobile devices to access virtually anything, anywhere and anytime** [Baird D. E., 2007; Wheeler S., 2009]. Technology experts as well propose the use of data mining (AI) and artificial intelligence to build e-Learning 3.0 systems that can sift and sort through large amounts of data, which lets the learner gain a "better understanding of the learning process itself" [Rubens N., Kaplan D., Okamoto T., 2011].

Furthermore, researchers in learning think that the fundamental concept of "anything, anytime and anywhere" will be enriched by "anyhow" given by 3D virtual worlds like the use of personal avatars and Second Life [Baird D. E., 2007; Rego H. *et al*., 2010]. Figure 7 presents main tools used in e-learning 3.0.


Figure 7. Main tools in e-learning 3.0 [Dominic M., Francis S., Pilomenraj A., 2014].

**There are four levels of e-learning** [Pattanayak S. P., Dash S., 2014]:

1. **Knowledge database:** students gain gradually training comparable to their assignment questions. Students use a search bar where short phrases can be typed in, and then they are presented with a catalogue of options.

2. **Online support:** students communicate with teachers using chat rooms and bulletin boards. Thus, the interaction between them occurs more efficiently.

3. **Asynchronous training:** a more convenient process in which students move at their speed and ask their questions via bulletin boards and chat rooms.

4. **Synchronous training:** this is carried out through audio-visual communications. Where all students log in, and a lecture is then given. This still permits students to raise their hands and ask questions verbally. **e-Learning in Web 3.0 is called e-Learning 3.0, which cuts across all the above stages alongside intelligent solutions.** It is "**read, write, connect, collaborate, anytime, anywhere with anyone".** It encourages better collaborative learning, enables students to come closer to "anytime, anyplace" education and provides intelligent web search, content organisation, and file management solutions.

e-Learning 3.0 is still an emerging concept, and thus, there is inadequate research conducted on e-Learning 3.0 models and frameworks [Binti A., Sofiadin M., Issa T., 2012].

Most researches focus on the technologies employed in e-Learning 3.0 like Big Data, Intelligent Agent [Rubens N., Kaplan D., Okamoto T., 2011], Semantic Web [Harris D., 2008] and Cloud Computing [Sharma S., Sharma D., 2009].

e-Learning 3.0 has at least four key drivers [Rubens N., Kaplan D., Okamoto T., 2011]**:**

1) **distributed computing,**
2) **extended smart mobile technology,**
3) **collaborative intelligent filtering,**
4) **3D visualisation and interaction.**

Distributed computing combined with smartphone technology allows students to be nearer to "anytime, anywhere" education and gives intelligent solutions for content organisation web search and document management. Also, it leads to a rise in auto-organised learning, motivated by easier access to the services and apparatus that enable us to customise our education recurrently. Combined intelligent filtering executed by intelligent agents allows users to work more collaboratively and smarter. 3D visualisation and interaction facilitate a wide range of activities, including fine motor-skill interaction, exploration of virtual worlds, and manipulation of virtual objects, promoting rich learning (Table 5) [Rubens N., Kaplan D., Okamoto T., 2011].

Table 5. Overview of e-learning 1.0, 2.0 and 3.0 characteristics [Rubens N., Kaplan D., Okamoto T., 2011].

## Review of Predictions: eLearning 3.0

| | e-Learning 1.0 | e-Learning 2.0 | e-Learning 3.0 |
|---|---|---|---|
| **Meaning is** | Dictated | Socially constructed | Socially constructed and Contextually reinvented |
| **Technology is** | Confiscated at the classroom door (digital refugees) | Cautiously adopted (digital immigrants) | Everywhere (ambient, digital universe) |
| **Teaching is** | Teacher to student | Teacher to student and student to student (progressivism) | Teacher to student, student to student, student to teacher, people-technology-people (co-constructivism) |
| **Classrooms are located** | In a building (brick) | In a building or online (brick and click) | Everywhere (thoroughly infused into society: cafes, bowling alleys, bars, workplaces, etc.) |
| **Teachers are** | Licensed professionals | Licensed professionals | Everybody, everywhere |
| **Hardware and software supply** | Are purchased at great cost and ignored | Are open source and available at lower cost | Are available at low cost and are used purposively |
| **Industry views graduates as** | Assembly line workers | As ill-prepared assembly line workers in a knowledge economy | As co-workers or entrepreneurs |

(adopted from Moravec 2009: 33) (Ogorshka 2011)

Artificial intelligence, especially intelligent multi-agents, is the foundation on which this 3.0 idea is built. It facilitates learning by interacting with the author and the student in many ways and collaborating and coordinating the flow of content in a sophisticated environment [Pattanayak S.P., Dash S., 2014].

First of all, in a world of Web 3.0, we will not only access the interpretative web with all its potential, but e-learning 3.0 will breach the limits of conventional institutions, and there will be a rise in auto-designed education. We will have less complicated access to the services and tools that allow us to customise our education, and these will be more easily summed up. In addition, with increased reliability of data storage and retrieval and the latest cloud computing, the mash-up is a feasible substitute for the gateway, resulting in less confidence in the localised provision. This may, in turn, accelerate the decline of the institutional Virtual Learning Environment. Second of all, several analysts think that e-learning 3.0 is all about mobile technologies. There will be the need for universal access to services, learning resources and tools, including subject specialists, expert support and people-peer learning group. There is little to hinder students everywhere from getting what they need on the go, from practically anywhere with smart mobile gadgets and improved connection by steadily advancing line-of-sight (wireless and satellite) networking services. The future digital divisions will not centre on "have and have not" socio-economic divisions rather will probably be "will and will not" mental divisions, as well as "can and cannot" skills divisions. Also, integrative education will be realistic from every perspective. e-Learning 3.0 will render associating across space much easier via prognostic filtering and hugely multi-user participative features. "(…) very little collaborative learning occurs through the use of wikis and blogs (…). In a recent post entitled: Is Twitter the semantic web? It is suggested that through its primitive filtering tools such as RT, DM, @ and #tagging, we are witnessing some of the early semantic features that enable users to work smarter and more collaboratively. Intelligent Agents will take this a lot further. Finally, 3D visualisation will become more readily available. Quicker processing speeds and higher screen resolutions will provide opportunities for smoother avatar-driven 3D interaction. Multi-gesture devices which will operate in 3D space will also become more widely available (…) 3D multi-touch interfaces will make a whole range of tasks easier including file management, fine motor-skill interaction, exploration of virtual spaces and manipulation of virtual objects" [Pattanayak S. P., Dash S., 2014].

## 2.6. Neuropsychological Impact of e-Learning

The research by Firth and others has demonstrated how changes in function weaken attentional capacities, social cognition abilities and memory processes in people [Firth J. *et al*., 2019]. Learning on an online platform needs the brain quickly move between activities, squandering metabolic energy. Visual stimuli are often complex and multi-method based (containing audio-visual pictures, text, and animations), resulting in digital multitasking and poor memory. Working memory overload is a major cause since it inhibits an individual's ability to register correctly, process, and recall information. **Because of multi-method based learning and divided attention, cognitive overload affects the quality of understanding, prioritisation, and deep-level processing of incoming data, which critically determines the consolidation of memory into long-term memory** [Carr N. G., 2010]. It consequently results in decreasing understanding and processing of what is said or taught. Moreover, children's social cognitive skills such as empathy, teamwork, and peer connections are affected when they are not in school [Jha A. K., Arora A., 2020].

In recent years, academics have been more interested in dissociative disorders, notably depersonalisation disorder (DPD). A sensation of detachment and unreality toward oneself or the outside world is a symptom of DPD. Depersonalisation and derealisation (DP=DR) symptoms span a spectrum of normal cognitive processes (such as daydreaming) to severe manifestations such as full-fledged chronic dissociative disorder [Aardema F. *et al.*, 2010].

According to epidemiological research, the lifetime incidence of DP=DR in nonclinical populations ranges from 34% to 70%, implying that some level of dissociation experience is a common occurrence. **Exposure to a virtual environment might cause dissociation experiences and a decreased sensation of presence in real life** [Aardema F. *et al.*, 2010].

Some instructors who are exposed to their students' issues during online learning may be encountering situations that have a detrimental influence on their mental health. Teachers can glimpse into their students' homes and, as a result, into the potential turmoil that is blossoming there [Blackburn S., 2020].

## 2.7. Virtual Reality in Education

**Virtual reality (VR) is a computer-generated occurrence comparable to or utterly dissimilar from the actual world.** "Virtual" has had the meaning of "being something in essence or effect, though not actually or in fact" since the late-1400s. The word virtual has been mentioned in the computer context as "not physically existing but made to appear by software" since 1959 [Online Etymology Dictionary, 2020].

The usefulness of virtual reality can include educational purposes and entertainment as video games (Figure 8). Another prominent virtual reality-style technology is mixed reality, often called extended reality or XR and augmented reality [Goode L., 2019]. One may differentiate between two kinds of virtual reality: text-based networked virtual reality (also called Cyberspace) and immersive virtual reality. The immersive VR changes the user's view when he moves his head. Whereas the two VRs are suitable for teaching, Cyberspace is ideal for distance teaching [Psotka J., 1995].

The beginning of exceptionally immersive VR technology is traceable to the 1960s in the amusement business with "Morton Heilig's single user console called Sensorama, designed to captivate audience attention" [Heilig M. L., 1962]. A spectacular heave of attention in the use of VR technology further than entertainment commerce emerged in the field of professional training and education in the 1980s. VR technologies were predominantly used for air flight simulator exercises and instruction [Hawkins D. G., 1995]. "The introduction of virtual reality technology in K-12 and higher education began in the early 1990s with projects such as Science Space, Safety World, Global Change, Virtual Gorilla Exhibit, Atom World, and Cell Biology" [Youngblut C., 1998].

Notwithstanding the challenges of pioneer VR technologies, the fast increase in the processing strength of the computer gave rise to the exploitation of desktop-based VR technology in K-12 and higher education. The severe decrease in the technology cost and the accessibility of fast Internet connection raised the utilisation of this less immersive kind of VR technology further [Dickey M. D., 2005, McLellan H., 2004]. While desktop-based 3-Dimensional virtual settings cannot render complete immersive knowledge, their photorealistic computer graphics have been demonstrated to improve students' engagement [Dickey M. D., 2003]. "Advances in technology have made it possible to use low-cost peripheral devices such as headphones, shutter glasses, and data gloves. (…) new possibilities of simultaneously allowing more than one user in a virtual environment to work collaboratively have also emerged" [Chen C., Teh S., 2000; Kamel Boulos M. N., Wheeler S., 2007].

Standard VR systems presently use VR headsets (Figure 9) or multi-projected environments to produce realistic sounds, images, and other ambiences that create a user's physical presence in a virtual setting. A user with virtual reality equipment may look around the virtual world, move in it, and interact with virtual features or objects. "Virtual reality generally includes audio and video feedback, but haptic technology may also enable additional sensory and physical input” [Wikipedia: Virtual Reality, 2021].


Figure 8. Using Virtual Reality in education [Larmand A., 2021].

Figure 9. Virtual reality headset [Hall C., 2020].

According to Furht, “**Augmented reality** (AR) is a type of technology that **blends what the user sees in his real surrounding with digital content generated by computer software”** [Furht B., 2006]. The extra software-produced images with the virtual prospect typically improve the way the actual environment looks in a certain way. Augmented reality systems layer virtual signals over a camera live feed to smart glasses or a headset or via a mobile gadget offering the user the aptitude to see 3D images (Figure 10). Augmented reality technology applies to overlay information on the physical world. For instance, the 3D replica, images or holograms, and sounds are superimposed over what the user hears and sees (Figure 11) [Prabhu S., 2018; Singh T., 2020]. Teachers attempt to use AR in classroom activities in order to supplement their students' textbooks with AR elements. It could pique learners' curiosity and encourage them to study [Singh T., 2020].

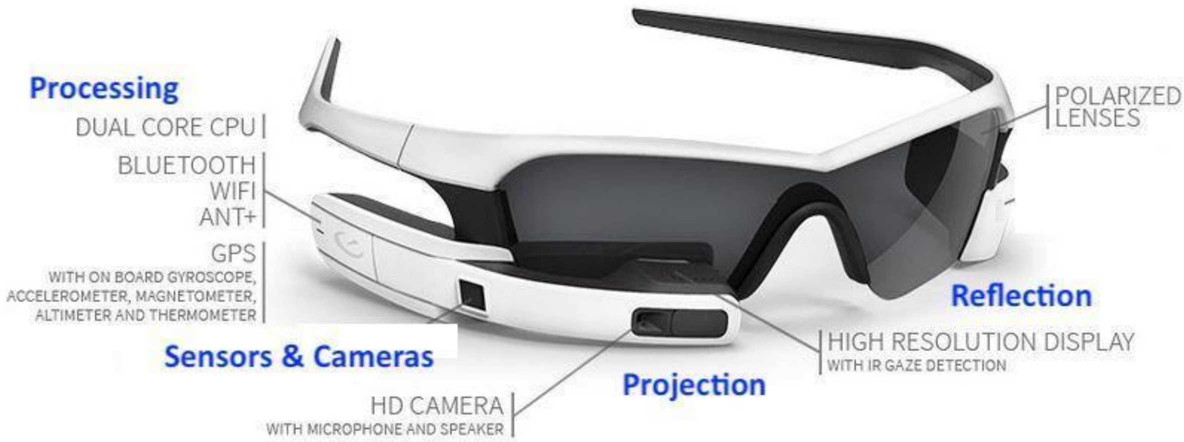



Figure 10. Augmented reality head-mounted display [Prabhu S., 2018].


Figure 11. Augmented Reality experience [Singh T., 2020].

AR and VR combine a digital world with our physical one. Although these two ideas have much in common, it is noteworthy to understand the way they diverge. AR overlays digital elements on top of a user's live view of their immediate physical world using a tablet or smartphone camera. VR is an immersive practice that changes a user's physical environment to a digital world through a display mounted on the head (Figure 12) [Poetker B., 2019].

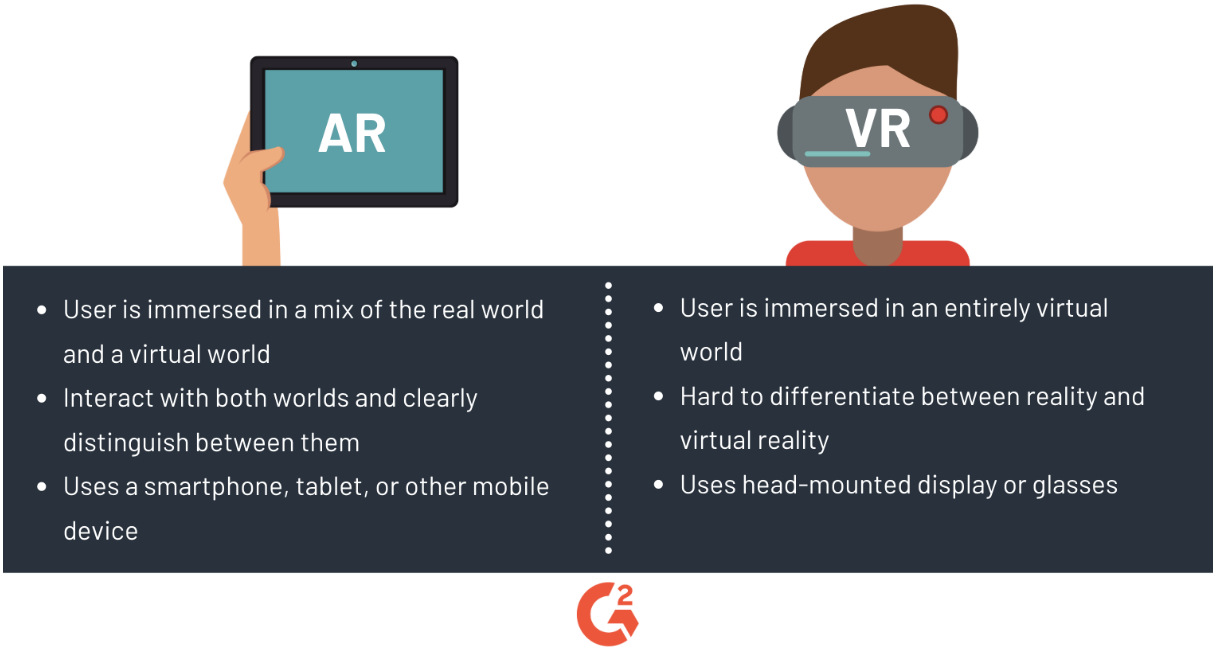



Figure 12. Augmented reality vs virtual reality [Poetker B., 2019].

Babich states that “Virtual reality can be used to enhance student learning and engagement (…) it works on the premise of creating a virtual world — real or imagined — and allows users not only to see it but also to interact with it”. Virtual reality promises some qualities that could be beneficial for education: “it presents environments in 3D, it is interactive, and it can give audio, visual and even haptic feedback. Presenting learning materials in 3D can be especially beneficial for teaching subjects where it is important to visualise the learning materials (e.g. in chemistry or engineering). (…) VR allows for direct interaction with the environment. Interactivity and feedback can be valuable for all subjects, as there are specific benefits of interactive learning because it promotes active learning” [Allcoat D., von Mühlenen A., 2018]. Industry and the military were early users of this training technology, and Walmart Inc. uses it in a new way to teach its employees in scenarios difficult to recreate, such as coping with spills or the chaos of Black Friday shopping [Atkinson K., 2019].

A few virtual environments, such as Second Life and Minecraft, have become more widely used in the previous decade. Crawling those virtual worlds revealed that Second Life is more commonly used in research and higher education. In contrast, Minecraft is more utilised in education as well as IT hardware and engineering. Virtual Science Centres, such as the Oddprofessor’s Science Center in Second Life, are the outcome of all this. This Science

Center is a virtual physics lab used by the students at the National Technical Institute for the Deaf over at the Rochester Institute of Technology [Richert A. *et al*., 2015].

Regarding public service, as Richert states, “there is already a variety of specialised simulations for education and training purposes, e.g. for the training of fire and medical emergencies a variety of virtual worlds exist, such as the transport and accident information and support system of the German chemical industry (TUIS-VR). Within five scenarios, firemen can train their behaviour in complex transport accidents with dangerous goods on motorways, rails and country roads. As most of the firemen have not been called very often to those accidents in their daily business, they can train their skills and decision processes of coping with those complex operations” [Richert A. *et al*., 2015].

These environments of VR training reveal that various fields exist in which creative problem solving is the vital competence to be trained. In addition, the training of team behaviour and competencies, like handling critical incidents, has been done in virtual worlds already [Heinrichs L. *et al*., 2008; Encarnação L. M., 2008; Höntzsch S. *et al*., 2013]. Most of the scenarios deal with situations that cannot be trained in real-world circumstances to that extent — for example, owing to expense or hazard. The benefits of virtual training for everyday engineering work are raised in higher education, particularly in engineering disciplines, to make engineering education in virtual labs and environments a norm rather than an exception [Richert A. *et al*., 2015].

Virtual reality has been likened to conventional education in some domains. In a research, a set of armed forces students were trained with either an immersive VR-based teaching method or lecture-based training methods that are conventionally employed for the subject area (“Corrosion Prevention and Control”) [Webster R., 2015]. The findings revealed that “whereas the traditional learning group had an 11% improvement, the VR group had a higher improvement of 26%”. Another research was carried out using simple online communicative simulations that imitated actual experiments. Eighty-three per cent of investigated students documented that they “found these online simulations helpful”, and their demonstrators said that the “students seemed much better prepared and more willing to answer questions when they had done the online simulations” [Bellamy M., Warren A., 2011].

In a study done in 2016 in high schools in Beijing, celestial physics was taught to students in a Virtual Reality or traditional way. The ratio between female and male students was about 1:1, and their academic performance ranged from A to C. Twenty students taught with Virtual

Reality mode stressed some benefits of VR learning (Figure 13). Compared to traditional teaching, most students (95%) found VR learning more interactive and immersive [Beijing Bluefocus, 2016].

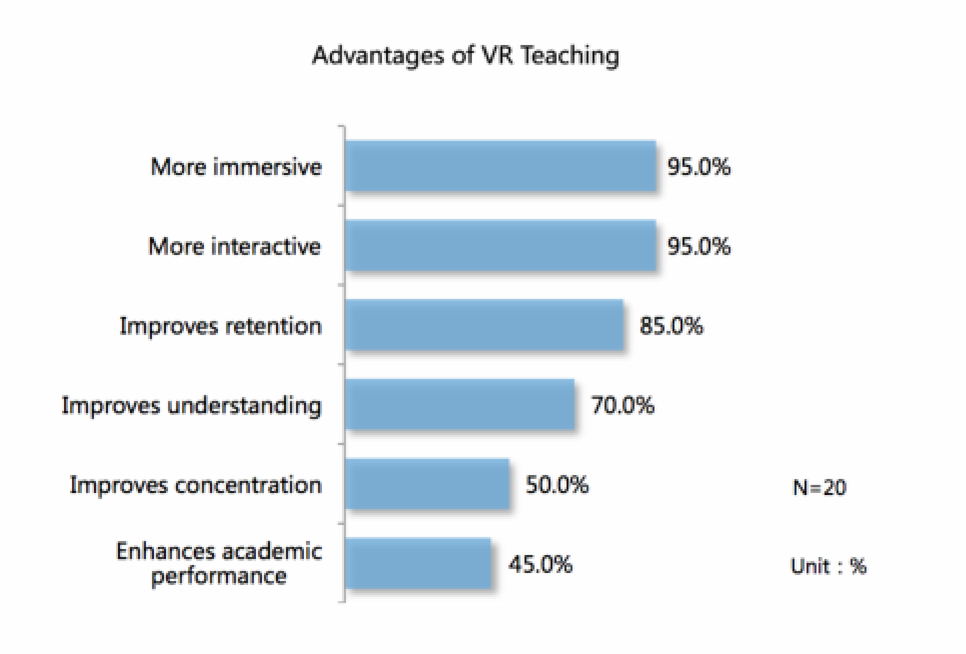



Figure 13. Some advantages of Virtual Reality learning emphasised by Beijing students (n=20) [Beijing Bluefocus, 2016].

The above study shows the way VR can complement or replicate traditional learning methods. It is crucial to note the way VR enables education beyond the classroom. Although the technology is appropriate for the classroom, it is also specifically well-situated for self-teaching, distance learning, and other educational settings. This can be accomplished because the gadget aids rich, comprehensive academic settings capable of being programmed for any situation. **Virtual Reality environments can make possible training that could not be simulated in reality (for example, dangerous experiments or environments) or would be too expensive (for instance, costly materials or equipment)** [Allcoat D., von Mühlenen A., 2018].

In general, Virtual Reality appears to be a prospective substitute to conventional textbook education, with comparable performance levels and enhanced engagement and mood. These advantages may possess a longer-term effect on education, including enhancements emanating from the teaching experience. Nevertheless, the outcome may be partially due to the newness of the Virtual Reality gadgets; thus, the development may not be persistent over longitudinal research. On the other hand, these developments could arise over time as people become more familiar with the tools and more contented with using them. A further longitudinal study is therefore needed to tackle these questions. Virtual Reality promises enormous potential, not just as an alternative to substitute or complement conventional teaching methods but also to build new educational experiences that have not been employed before [Allcoat D., von Mühlenen A., 2018].

The use of VR in education shows the ability to "**promote higher-order thinking, foster student interest and engagement, support knowledge acquisition, promote mental habits and understanding"** [Sáez-López J. M., Sevillano-García M. L., Pascual-Sevillano M. A., 2019]. Numerous studies on the use of VR in education produced positive results, cutting across more time-on-task [Huang H.-M., Rauch U., Liaw S.-S., 2010; Johnson A. *et al*., 1998], to motivation [Jacobson J., Holden L., 2005; Cheung S. K. S. *et al*., 2013; Sharma S., Agada R., Ruffin J., 2013], enjoyment [Ferracani A., Pezzatini D., Del Bimbo A., 2014; Apostolellis P., Bowman D. A., 2014], "deeper learning and long-term retention" [Rizzo A. A. *et al*., 2006; Huang H.-M., Rauch U., Liaw S.-S., 2010].

Some analyses suggest that immersive virtual reality could be used as a venue for educational learning and a substitute for traditional media, like slideshow presentations. Parong and Mayer carried out a comparison study on media, where learning educational material through one medium is compared with learning the same material through another medium [Parong J., Mayer R. E., 2018]. A tiny but increasing compendium of research comparing training with traditional media to games and simulations presented on desktop computers exists [Honey M. A., Hilton M. L., 2011; Mayer R. E., 2014].

Examples of AR are prevalent in gaming, education, travel, movies, marketing, etc. This technology gives opportunities for existing and new businesses (Figure 14) [Singh T., 2020].

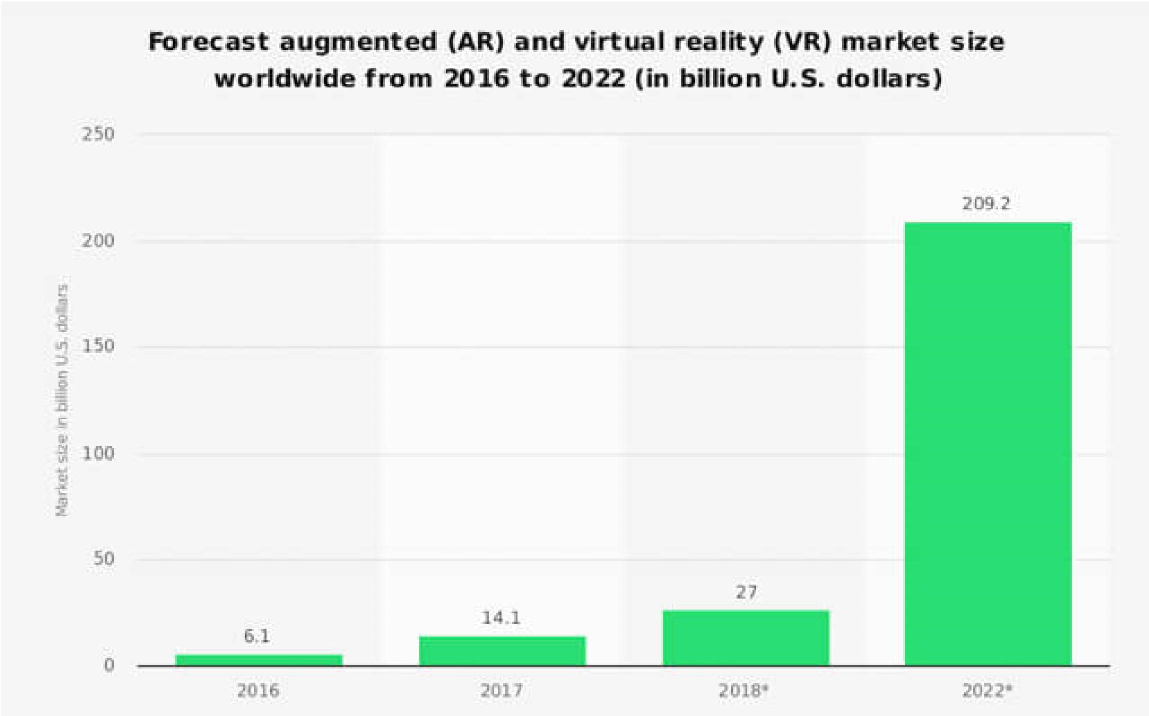



Figure 14. Augmented reality and virtual reality market worldwide [Singh T., 2020].

## 2.8. Artificial Intelligence in e-Learning

Poole and others state that "in computer science, artificial intelligence is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and animals. Leading AI textbooks define the field as the study of 'intelligent agents': **any device that perceives its environment and takes actions that maximise its chance of successfully achieving its goals**" [Poole D., Mackworth A., Goebel R., 1998]. A more extensive definition characterises AI as "**system's ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation**" [Kaplan A. M., Haenlein M., 2019]. This field was based on the postulation that human intelligence "can be so precisely described that a machine can be made to simulate it" [Dartmouth workshop, 1956]. AI is characterised by being **responsive, decisive, adaptive, and independent** (Figure 15).

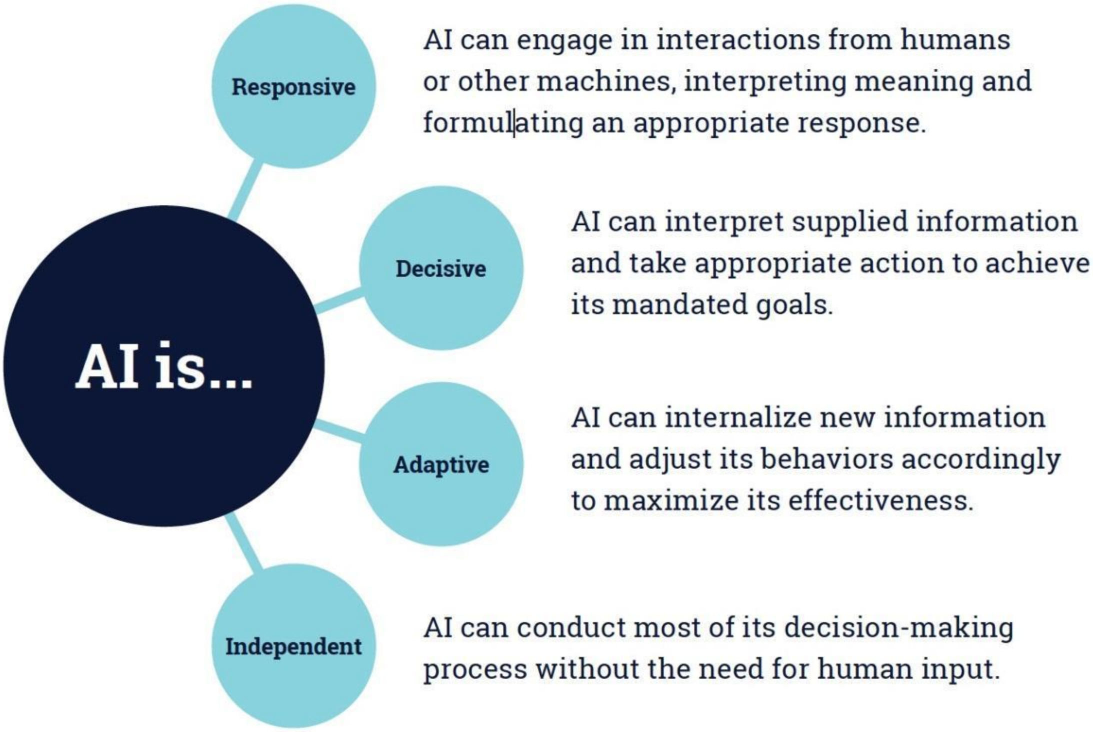



Figure 15. Basic characteristics of artificial intelligence [Bates T., 2018].

AI is the engineering and science of building intelligent devices, principally intelligent computer programmes. It is like employing a computer to comprehend human intelligence. Traditional teaching can be made more effective by AI [Bele S. B., 2018].

"Artificial intelligence can act as a virtual tutor and answer questions on the fly" [Reddy D., 2018]. The inability to clear doubts as soon as they crop up in mind is among the significant issues an individual encounters while learning. At times it is just the "fear of looking unintelligent" [Reddy D., 2018] or simply that the teacher is unavailable. Or in the situation of looking things up online, a student probably does not want to disrupt his learning. But learners need to ask questions immediately because otherwise, it will only complicate the learning process [Kolagani S., 2019].

As per Kolagani, "Integrating AI into e-learning courses can avoid the need to go to the instructor or look it up on the Internet every time a slight confusion arises during learning. All one would need to do is ask the AI engine and receive the appropriate answer. AI can learn 'mountains of data' if trained properly" [Kolagani S., 2019].

AI can track a user's performance and utilise that information to adapt current educational materials, resulting in a more personalised learning experience. Artificial Intelligence can trail learners' progress within an e-learning course, which helps spot areas where each student is deficient and adjusts the material accordingly [Kolagani S., 2019].

Neelakandan shows some areas where an AI-based e-learning platform can improve online learning [Neelakandan N., 2019]:

1) Real-time questioning

Among the critical functions of an AI-based e-learning platform is its capability to act as a teacher and **give answers to questions in real-time.** With AI, students can ask questions and get instant responses to a topic that is not clear.

2) Generate new course content

Course content preparation is a time-consuming aspect of e-learning. If properly trained, **AI systems can help with data extraction and conversion into smart content for digital learning. It allows professionals to focus on creating an engaging digital learning experience for their students.**

3) Customised teaching session

Instructors benefit from e-learning since it lets them generate information shared with various students. A lecturer's ability to meet the expectations of all students at the same time is nearly impossible. Of course, in corporate training, this one-size-fits-all approach is ubiquitous. However, it is not the optimal technique because everyone has a distinct learning style that must be considered while providing knowledge. Artificial intelligence is crucial to examine a learner's previous performance and determine his learning style. Before offering a customised learning experience, AI utilises the data to improve the new learning content.

4) Gamification

Gamification is a vital system utilised in e-learning to motivate and engage students to gain new knowledge (Figure 16). "Duolingo is one of the most popular language-learning apps in the world. Its gamified model incorporates competition through levels and points, spacing with daily reminders, and even a social generation aspect with online discussion forums" [Källqvist O., 2019]. Lok states that "(…) the demand for gamification has boomed.

According to The Huffington Post, over 350 companies, including the likes of NBC and Panera, have invested in major gamification programmes for their respective media" [Lok D., 2019].


Figure 16. Core elements of gamification [Lok D., 2019].

Cheong et al. (2014) conducted research among 51 undergraduate IT students to obtain their perceptions of gamification in learning. Most students (93.75%) consider gamification in education to be beneficial. Many people feel that incorporating technology into school would improve the learning environment and make lessons more entertaining. One student stated that with gamification in education, "people may actually show up to class", while another believed that gamification would increase class participation, "if there are other benefits (to attending class) then there are more incentives to participate". The first statement is about the alarming trend of declining student attendance in courses, while the second is about better encouraging and engaging students to not only attend classes but also engage in class discussions (Figure 17) [Cheong C., Filippou J., Cheong F., 2014].

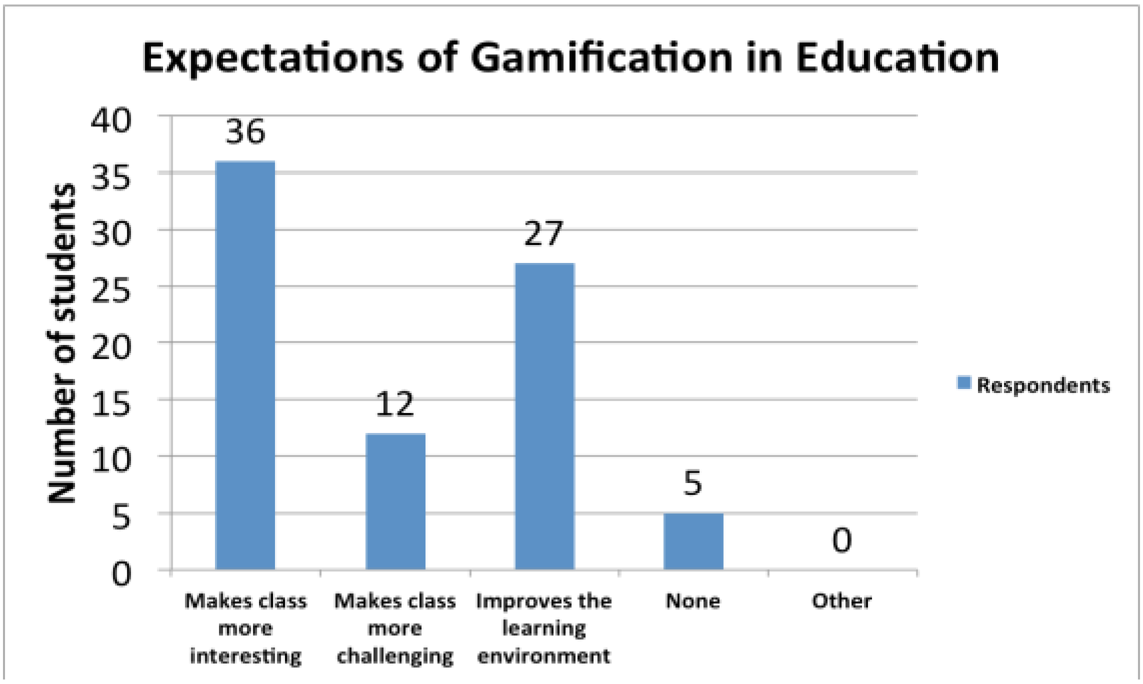



Figure 17. Student expectations of gamification in education [Cheong C., Filippou J., Cheong F., 2014].

In a recent study by Duggal, Gupta and Singh (2021), authors compared students' attendance between non-gamified and gamified courses. It turned out that participants were more motivated to attend the gamified classes "that included a coin-based attendance system, fun-based learning, online quiz, and verbal discussion" (Figure 18) [Duggal K., Gupta L. R., Singh P., 2021].

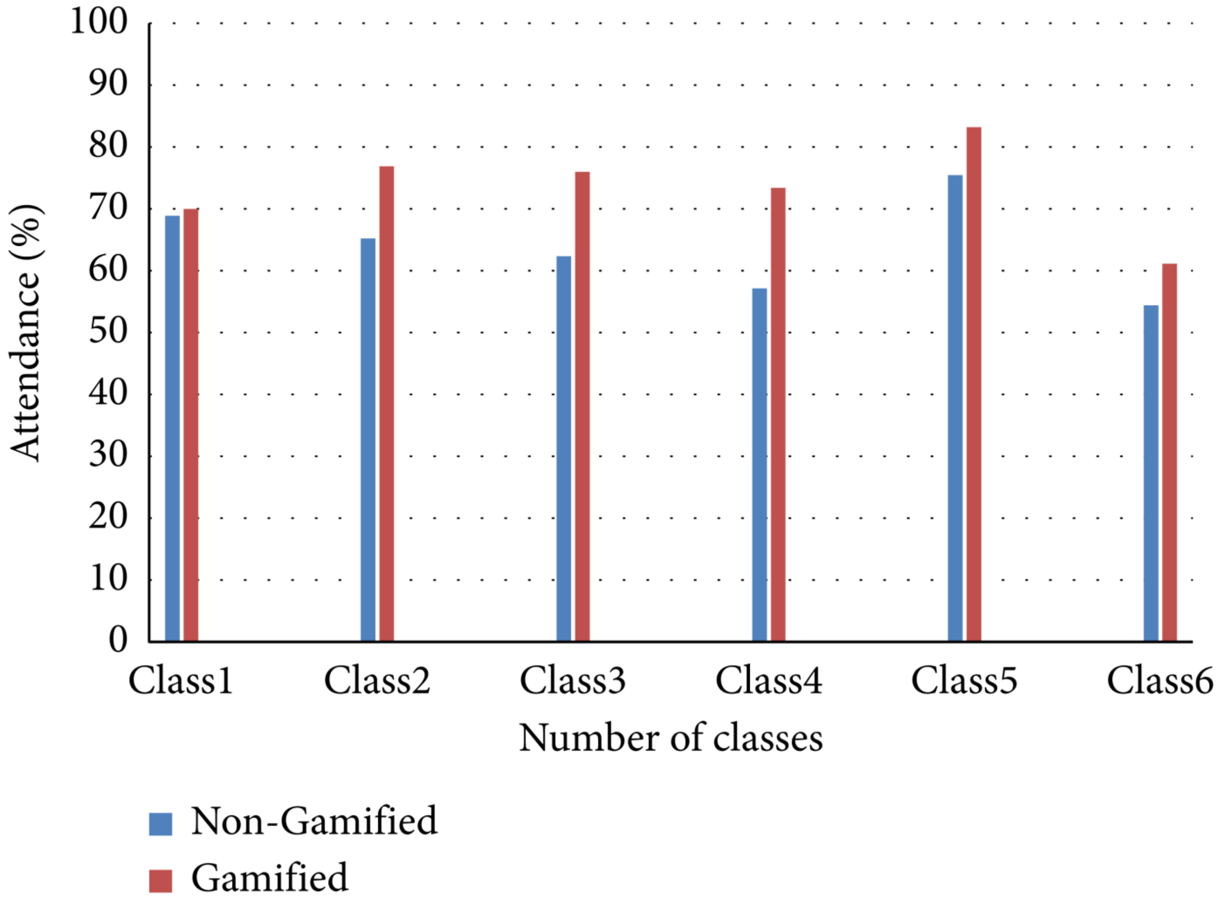



Figure 18. Attendance comparison of non-gamified vs gamified classroom learning [Duggal K., Gupta L. R., Singh P., 2021].

AI makes it easy to plan strategic games for online learning material. It facilitates the processing of a great deal of data to identify a student's attitude and provide updates on their academic progress.

Using artificial intelligence in education is expected to explode in the global market. Only in the U.S., the education market, which includes primary and secondary education, postsecondary education, and corporate training, is expected to rise by more than half, to $3.4 billion by 2024 (Figure 19) [Molnar M., 2018].

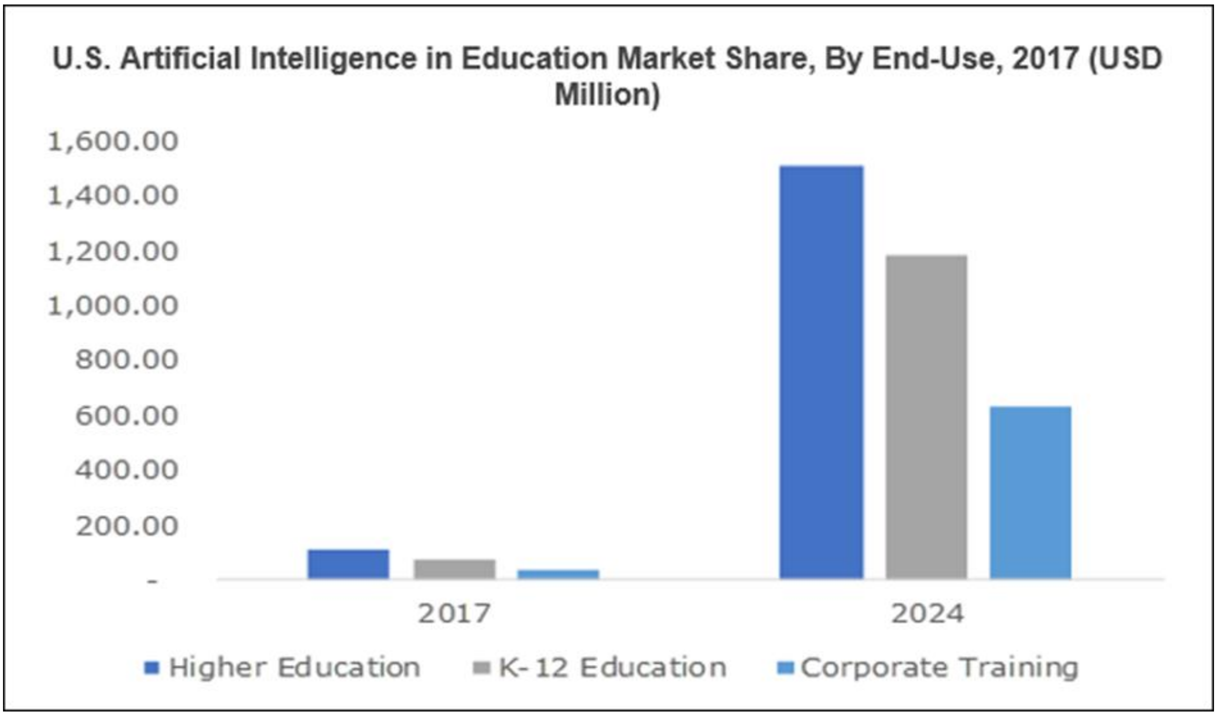



Figure 19. U.S. Artificial Intelligence in education market share [Molnar M., 2018].

### 2.8.1. Impact of Artificial Intelligence in Enhancing Virtual Learning Environment

**A virtual learning environment (VLE) for e-learning is a system that contains learning resources such as videos, audios, texts, articles, forums, chat, case studies, and exercises, all of which interact with the student through the use of language that facilitates learning** (Figure 20) [Solano J. A., 2010; Lavigne G. et al., 2015]. Such systems involve student tracking, evaluation, communication and collaboration tools. The VLE aims to render support to students remotely anywhere and anytime to study without time and geographical restraints. It is commonly valuable for students registered in part-time courses, working part-timers and distant learning. The standard method applied in VLE is to make the course content available from the online resource centre of the institution [Kavitha V., Lohani R., 2019].

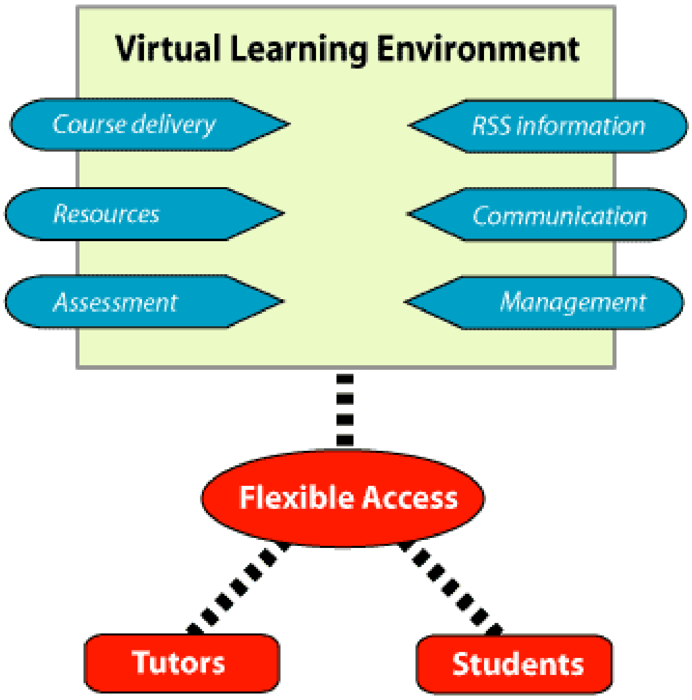



Figure 20. Structure of Virtual Learning Environment [Solano J. A., 2010].

To improve the user's experience and make learning easy, AI is used by service providers in learning management systems. Artificial Intelligence methods are also used to aid the analytical process to customise course completion to each student's need. A number of them are employed to learn from student behaviour to correct suggested software pedagogy [Mayer R. E., 2010].

AI is used at different levels of the educational process [Kavitha V., Lohani R., 2019]:

- diagnosis of the present knowledge level of the learner in the perspective of the chosen course,
- analysis of the speed and level of learning during the course,
- suggestions for modules to meet necessary learning to advance further in the course,
- changes in teaching based on the needs of the learners,
- continuous interval assessment of learning,
- tracking on and off a learning site to assess student behaviour during the learning process,

- explaining complex topics in more depth and in a variety of methods to deliver knowledge,
- adapting diverse multimedia presentations to a student’s learning style.

### 2.8.2. Scope of AI in e-Learning

Adaptive educational systems stress the significance of individual differences in replicating the best online learning setting. **Recognising and paying attention to individual student capabilities and needs is fundamental to rendering adaptive e-learning systems.** As a result, accurate student profiles must be created to examine their emotional states, degree and kind of knowledge, personality traits, and skills [Shute V. J., Zapata-Rivera D., 2012].

The educational approach that includes AI aims to combine the ability to understand and detect a person’s specific needs in the context of learning with the expertise required to use appropriate learning pedagogy and enhance the learning process to bring adaptive e-learning services and study materials that are tailored. These learner models and data may be used in two ways once they have been gathered. The first is to inform the pedagogy offered by the adaptive educational system’s specialists and designers. The second is to give dynamic self-learning capabilities to the system based on an instructor’s or student's behaviour. Learner analytics and educational data mining are two important overlapping fields that might play a role in developing such capabilities. Artificial intelligence models, capable of evolving and emulating the human decision-making process, are also valuable in acquiring such skills. As a result, it is required to study and investigate current and related subjects in adaptive learning environments, such as massive open online courses, learner analytics, educational data mining, and associated artificial intelligence approaches in greater depth [Almohammadi K. *et al*., 2017].

### 2.8.3. Artificial Intelligence in MOOCs

The major challenge regarding MOOCs is gathering massive sets of data from student's interactions with their academic settings and integrating them with AI techniques to generate knowledge of adaptive human learning. These techniques can be used to envisage success. In that case, the next significant step could be to employ analytics to drive customised systems adapted to student needs and preferences based on the composing instances of students' behaviour and previous students' data [Haggard S., 2013]. According to recent studies, "there are high dropout rates in the number of students enrolled in massive open online courses, and completion rates in these courses are less than 13%" [Onah D. F. O., Sinclair J., Boyatt R., 2014]. "Adaptive academic learning powered by analysis of students' behaviour could be the solution. Learning interaction analyses are not just beneficial for academic reasons; they also help students obtain feedback on their performance and learning styles. However, despite the capabilities of learning analytics technologies and tools, there is a need for human interpretation of the data" [Fournier H., Kop R., Sitlia H., 2011].

### 2.8.4. Intelligent Tutoring System (ITS)

Bele states that **"an Intelligent Tutoring System is a computer system that aims to provide immediate and customised instruction to learners, usually without requiring intervention from a human teacher"** [Bele S. B., 2018]. It is challenging to supply each student with a personal training helper. On the other hand, a virtual training assistant that captures professional trainers' subject matter and teaching expertise is an interesting alternative. Researchers in education, psychology, and artificial intelligence have worked on the Intelligent Tutoring System [Bele S. B., 2018].

Novel computer-facilitated instruction concepts, like distributed learning and e-learning, gave a perfect stage for ITS ideas during the swift growth of the web boom. Natural language processing, planning, semantic Web, machine learning, multi-agent systems, ontologies, and social and emotional computing are areas where ITS has been applied. ITS has also been linked to other technologies like multimedia, object-oriented systems, modelling, simulation, and statistics. "Educational sciences and psychology have also been influenced by the success of ITS" [Ramos C. *et al*., 2009].

ITSs have the general aim of allowing education in an effective and meaningful way via various computing technologies. Many examples of ITSs being employed in professional settings and formal education have shown their strengths and limitations. Intelligent tutoring, cognitive learning theories and design have a strong link, and there is continuous research to increase the effectiveness of ITS. In situations where students would usually have access to one-to-many teaching from a single instructor (e.g., classroom lectures) or no teacher at all (e.g., online assignments), ITS typically tries to emulate the established benefits of one-to-one, customised tutoring [VanLehn K., 2011]. ITSs are often designed to provide access to high-quality education for every student.

**Today's ITSs aim to mimic a teacher's job, and they progressively automate pedagogical activities, including issue formulation, problem selection, and feedback generation.** Recent work on ITSs has been concentrating on ways these systems may harness successfully the complementing capabilities of human-led education from a teacher [Miller W. L. *et al.*, 2015] or peer [Diziol D. *et al.*, 2010] when utilised in classrooms or other social situations [Baker R. S., 2016].

ITS comprises four fundamental elements based on an agreement amongst researchers [Nwana H. S., 1990; Freedman R., Ali S. S., McRoy S., 2000; Nkambou R., Mizoguchi R., Bourdeau J., 2010]:

1. **Domain model**
2. **Student model**
3. **Tutoring model**
4. **User interface model**

**The domain model** (also referred to as "the cognitive model or expert knowledge model") is founded on a theory of learning, like the ACT-R theory that attempts to consider all the probable steps needed to provide a solution to a problem. More specifically, this model "contains the concepts, rules, and problem-solving strategies of the domain to be learned. It can fulfil several roles: as a source of expert knowledge, a standard for evaluating the student's performance or for detecting errors, etc." [Nkambou R., Mizoguchi R., Bourdeau J., 2010]. Another approach to domain model development is founded on "Stellan Ohlsson's Theory of Learning from performance errors" [Ohlsson S., 1996], tagged "constraint-based modelling" [Ohlsson S., 1992]. The domain model, in this case, is given as a set of limitations on correct solutions [Mitrovic A., Ohlsson S., 2006; Ohlsson S., Mitrovic A., 2007].

**The student model** can be seen as a cover on the domain model. It is the major element of an intelligent tutoring system, focusing primarily on students' affective and cognitive conditions and their change as the education process progresses. As the students work gradually through solving problems, an intelligent tutoring system engages in a process known as model tracing. The system flags or identifies an error each time the student model strays from the domain model. Conversely, the student model is represented as an overlay on the constraint set in constraint-based tutors [Mitrovic A., Ohlsson S., 1999]. "Constraint-based tutors [Mitrovic A., 2010] evaluate the student's solution against the constraint set, and identify satisfied and violated constraints. If there are any violated constraints, the student's solution is incorrect, and the ITS provides feedback on those constraints" [Zakharov K., Mitrovic A., Ohlsson S., 2005; Mitrovic A., Martin B., Suraweera P., 2007]. "Constraint-based tutors provide 'negative' feedback (i.e. feedback on errors) and 'positive' feedback" [Mitrovic A., Ohlsson S., Barrow D., 2013].

**The tutor model** considers data from the domain and student models when deciding on tutoring techniques and actions. The learner may seek help on what to do next during the problem-solving process. In addition, the system recognises when the learner has departed from the model's production norms and gives timely feedback, resulting in a faster time to master the targeted abilities [Koedinger K. R. *et al*., 1997]. "The tutor model may contain several hundred production rules that can be said to exist in one of two states, learned or unlearned. Every time a student successfully applies a rule to a problem, the system updates a probability estimate that the student has learned the rule. The system continues to drill students on exercises that require the effective application of a rule until the probability that the rule has been learned reaches at least 95% probability" [Corbett A. T., Anderson J. R., 1992].

Knowledge tracing trails the student's progress from problem to problem and develops an outline of weaknesses and strengths for production rules. The cognitive tutoring system, created by John Anderson at Carnegie Mellon University, gives information from knowledge tracing as "a *skillometer,* a visual graph of the learner's success in each of the monitored skills related to solving algebra problems. When a learner requests a hint or an error is flagged, the knowledge tracing data and the *skillometer* are updated in real-time" [McKinney S., 2018].

**The user interface model** incorporates three categories of information required to conduct a dialogue: 1) knowledge of patterns of interpretation (to comprehend a speaker) and action (to produce utterances) within conversations, 2) domain knowledge for expressing content, and 3) knowledge for communicating purpose [Padayachee I., 2002].

ITSs present several general behaviours and characteristics related to particular architectural components. Table 6 highlights five architectural elements and their related features. It is predicted that these features apply to evaluate and compare the existing intelligent tutoring system and channel the design of a new intelligent tutoring system/s. Certain application domains (mathematics, programming, geography, etc.) affect the behaviour and architecture of intelligent tutoring systems and design paradigms (coaches, problem-solving monitors, microworld, diagnostic tutors, etc.). Therefore, many characteristics may not be integrated into some architectures [Padayachee I., 2002].

Table 6. Generic characteristics/behaviour of an ITS [Padayachee I., 2002].

| **ITS Architecture** | **Characteristics/Behaviour** |
|---|---|
| **Domain Model** | *Intelligent tutoring systems should:* Possess system domain knowledge to make inferences or solve problems; Provide explanations of problem solutions; Give alternative explanations of the same concept; Answer arbitrary questions from the student; Incorporate knowledge about common misconceptions and missing concepts. |
| **Tutoring Model** | Possess system teaching goals & plans; Provide alternative teaching strategies; Be guided by an underlying instructional theory; Tailor system's teaching strategies with student's needs; Allow student to initiate instructional activities; Provide contextualised, domain-relevant and engaging learning activities; Diagnose misconceptions and learning needs; Intervene if the student appears to be having difficulty; Relate a diagnosed error to a misconception or a missing concept; Incorporate remedial strategies in order to provide alternative remedial teaching styles. |
| **Student Model** | Maintain information about the student's knowledge, and skills (current and advancing) in the student model; Store information on the student's cognitive processes; Store information on student's learning preferences and/or past learning experiences in the student model, if the need arises; Monitor and assess student performance and update student model. |
| **System Control** | Provide helpful feedback on student input; Treat all detected errors; Respond if it cannot diagnose an error; Intervene to remediate a misconception or a missing concept; Adapt to student's level of advancement; Adapt to the needs and preferences of the student. |
| **User interface** | Promote ease of use; Incorporate natural interaction dialogues; Ensure that the dialogue is task-oriented and adaptive; Possess an effective screen design; Embrace a variety of interaction styles. |

Records of advancements in student understanding, motivation attitude, engagement, and academic outcomes have contributed to these systems' current research and investment. The customised nature of ITSs enables educators to develop personalised programmes [McKinney S., 2018].

### 2.8.5. An Overview of Artificial Intelligence Methodologies Employed for Adaptive Educational Systems

Adaptive educational systems aim to channel the whole educational approach to accomplish students' requirements. Thus, the students' models and profiles should be developed precisely to evaluate their levels of knowledge, affective states, personality traits, and skills. The required information needs to be developed and used to enhance the adaptive learning environment [Essalmi F. *et al*., 2010]. Thus, AI methods are considered essential tools, as they can create and model the decision-making process used by people [Frias-Martinez E. *et al*., 2004]. Different AI techniques are engaged in adaptive educational systems, like **fuzzy logic, decision tree, Bayesian networks, neural networks, genetic algorithms, and hidden Markov models.**

As defined by Novák et al., "**fuzzy logic** is a form of many-valued logic in which the truth values of variables may be any real number between 0 and 1, both inclusive. It is employed to handle the concept of partial truth, where the truth value may range between completely true and completely false" [Novák V., Perfilieva I., Močkoř J., 1999] while in boolean logic there is only an absolute truth value 1.0 and absolute false value 0.0 (Figure 21). Fuzzy logic is founded on the idea that people decide based on non-numerical and imprecise information. "Fuzzy models or sets are mathematical means of representing vagueness and imprecise information (hence the term fuzzy). These models have the capability of recognising, representing, manipulating, interpreting, and utilising data and information that are vague and lack certainty" [Yılmaz O., Görür G., Dereli T., 2001].

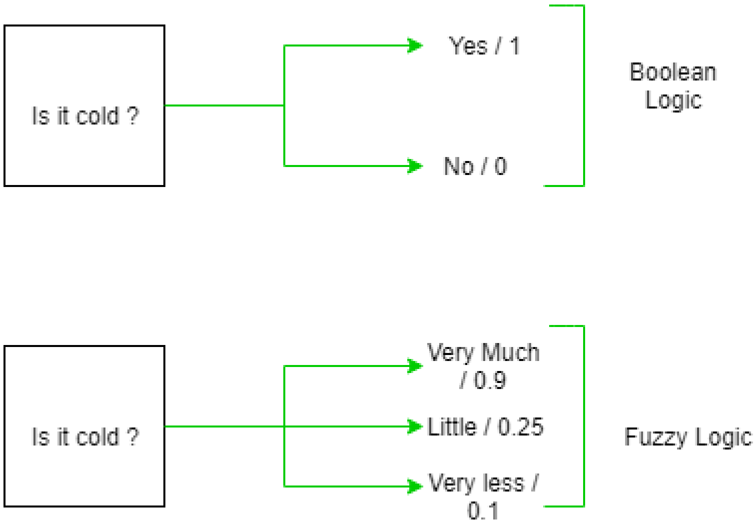



Figure 21. Boolean logic vs fuzzy logic [GeeksforGeeks, 2019].

**A decision tree** is a method for making decisions that uses a tree-like model of options and their potential consequences, such as event outcomes, chance, resource costs, and usefulness. It is one way of showing an algorithm that is made up completely of conditional control statements (Figure 22) [Raj S., 2019].

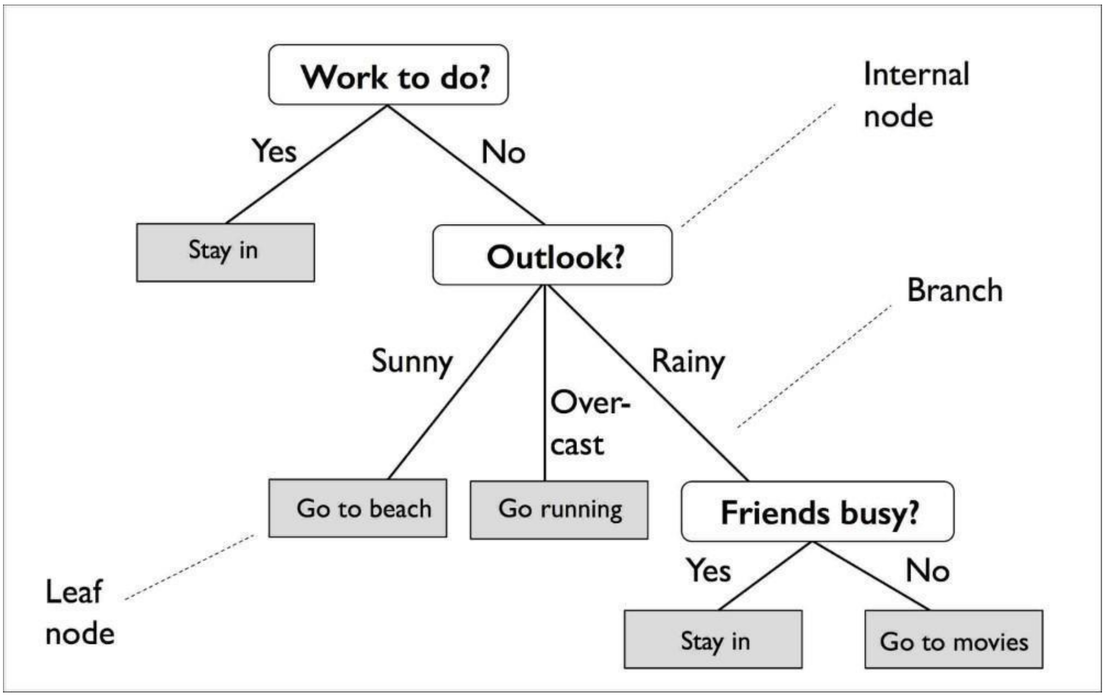



Figure 22. The decision tree [Lorraine L., 2019].

Decision trees are used in operations research, particularly in decision analysis, to identify a tactic that will most likely achieve a goal. They are also a standard tool in machine learning [Visual Paradigm Online, 2020].

**"A Bayesian network** is a probabilistic graphical model (a type of statistical model) that represents a set of variables and their conditional dependencies via a directed acyclic graph" [Soni D., 2018]. Bayesian networks are suitable for taking an event and forecasting the possibility that any of many likely known causes were the contributing factors [Horný M., 2014]. An example of a Bayesian network construction can be a student evaluation model (Figure 23).

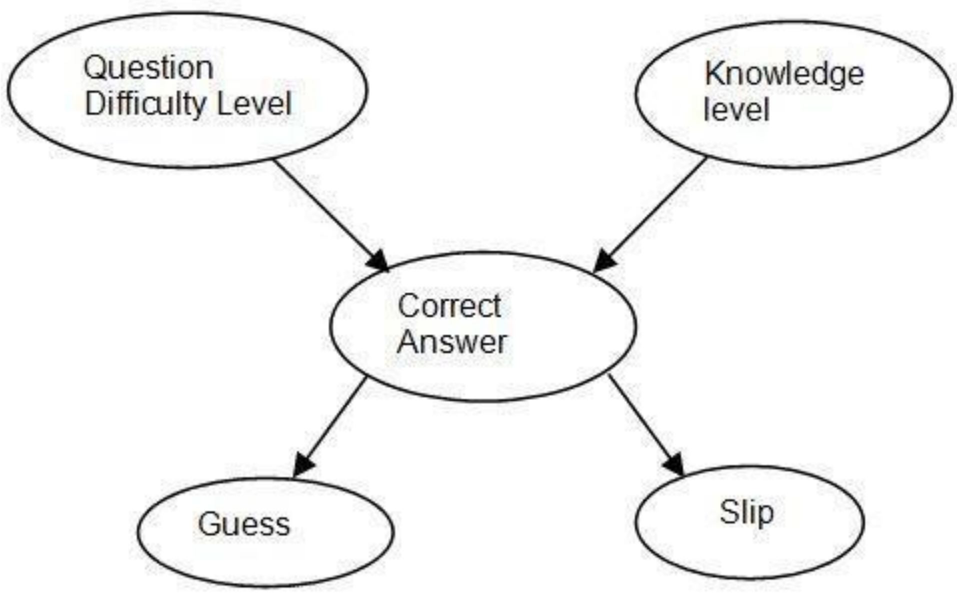



Figure 23. Student evaluation model using Bayesian network [Chakraborty B., Sinha M., 2016].

**A neural network** is "a network or circuit of neurons, or in a modern sense, an artificial neural network, composed of artificial neurons or nodes" [Hopfield J. J., 1982]. Therefore, a neural network is an artificial neural network used to solve problems or a biological neural network comprising actual biological neurons. "The connections of the biological neuron are modelled as weights. A positive weight reflects an excitatory connection, while negative values mean inhibitory connections. All inputs are modified by weight and summed. This activity is referred to as a linear combination. Finally, an activation function controls the amplitude of the output. For example, an acceptable output range is usually between 0 and 1, or it could be −1 and 1” [Gurney K., 1997]. Figure 24 illustrates the architecture of an artificial neural network [Bre F., Gimenez J. M., Fachinotti V. D., 2018].

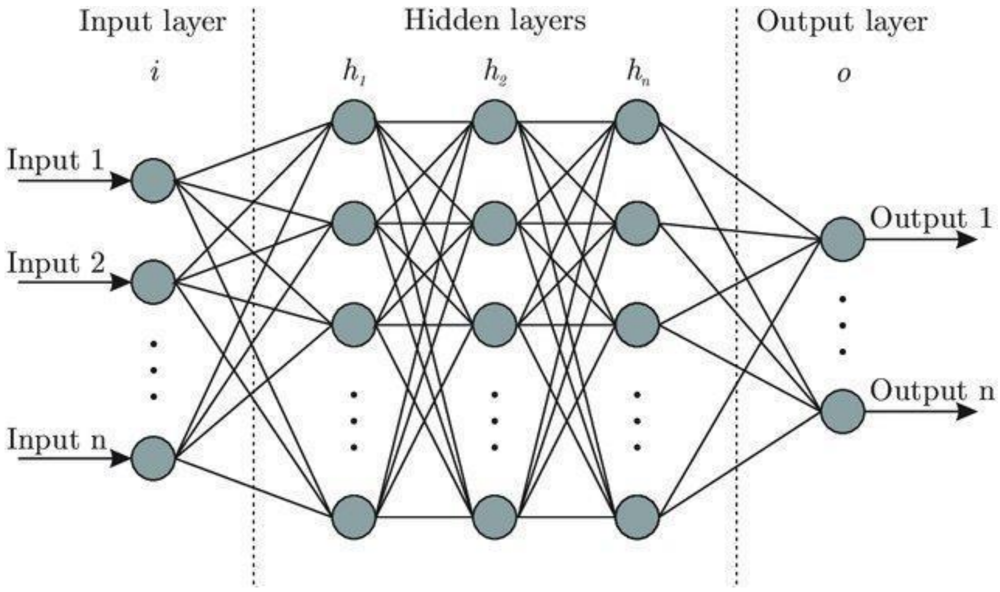



Figure 24. Artificial neural network architecture [Bre F., Gimenez J. M., Fachinotti V. D., 2018].

**A genetic algorithm** refers to strategy systems employed in artificial intelligence and computation. Ideal answers that probe into difficulties founded on ideas of selecting nature and the evolution of living organisms are achieved through this strategy. Sets of data that are huge and not straightforward are effectively examined through these systems. Genetic algorithms are regarded as providing satisfactory answers to complex problems [Techopedia, 2019].

**Hidden Markov models** refer to one of the generally accepted ways in machine learning and statistics for modelling sequences such as speech or proteins [Beal M. J., Ghahramani Z., Rasmussen C. E., 2002]. They are identified with their usage in enhancing learning [Kabudian J., Meybodi M. R., Homayounpour M. M., 2004]. Figure 25 shows the basic structure of a hidden Markov model.

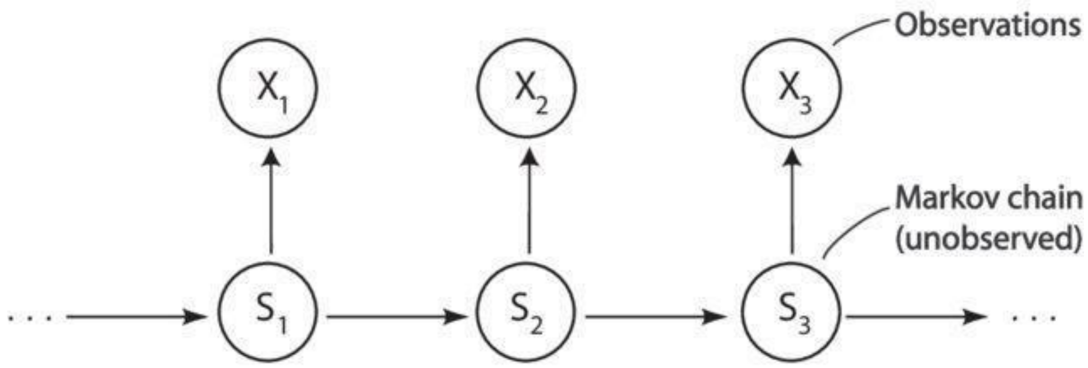



Figure 25. The basic structure of a hidden Markov model [Bulla J., 2006].

In suitable educational systems, Artificial Intelligence advances are applied in diverse manners. For instance, the main target is to inspect and evaluate student's features in some structures, to draw out the reputations of students so that the aggregate assessment of their learning degree can be applied as a determinant for specified software teaching [Gertner A. S., VanLehn K., 2000; Ma J., Zhou D. N., 2000; Gamboa H., Fred A., 2001; Seridi-Bouchelaghem H., Sari T., Sellami M., 2005; Cin F. M., Baba A. F., 2008; Venkatesan S., Fragomeni S., 2008; Sripan R., Suksawat B., 2010]. Diagnostic operations are also enhanced using AI, thereby changing what is contained in students' lessons and providing what learners need. Also, the attitudes of students are studied by some of them to modify the specified software teaching [Xu D., Wang H., Su K., 2002; Moreno F. *et al.*, 2005; Seridi-Bouchelaghem H., Sari T., Sellami M., 2005; Cha H. *et al*., 2006; Idris N., Yusof N., Saad P., 2009; Gutierrez-Santos S. et al., 2010].

However, the majority of current adaptive educational systems do not learn from behaviours. Adaptive educational systems that are based on the ideas of a small group of experts or designers to address student behaviour may be marked by a variety of causes of uncertainty regarding a learner's response evaluation using such a system, which is connected to a learner's reception of instruction. This type of learning-teaching choice is frequently required when dealing with ambiguous information (we are unsure if the given information is accurate) and/or imprecise (the values handled are not fully defined) [Bursilovsky P., Millán E., 2007]. For instance, one thing we are supposed to tackle should be: if the learner's brilliancy in Excel is poor and in PowerPoint is excellent, in that case, they should study Excel materials. AI techniques are creative approaches to dealing with an impression, ambiguity, and incomplete truth, and they can handle the inherent uncertainty that human decision-making possesses. These AI systems are beneficial for various reasons, including their ability to generate and imitate human decision-making processes and build automated and precise teaching-learning models [Ahmad A., Basir O., Hassanein K., 2004].

### 2.8.6. What are the AI solutions enhancing e-learning platforms?

Coursera, which is best known for its academic classes, is presently one of the most well-known online learning platforms. It emphasises the significance of Artificial Intelligence in its instructional offer. Both university and professional courses exist in AI for business (e.g. business analytics), machine learning, digital strategy and other high demand fields like IT and cloud engineering; they also have free learning resources for universities and college students. The platform was co-founded by Andrew Ng, a well-known AI and ML researcher, professor at Stanford University, who also co-founded Google Brain and deeplearning.ai [Polachowska K., 2019].

Coursera tracks users' on-site activities, such as viewed courses or/and enrolled ones. This is done to suggest classes that may interest a user. It works much like the recommendation system of Amazon, LinkedIn, Netflix or Pandora [Polachowska K., 2019].

Students can also be assisted by AI daily. "Jill Watson is a graduate-level artificially intelligent teacher assistant. Jill helps students in the Knowledge-Based Artificial Intelligence course at Georgia Tech. Jill was implemented on IBM's Watson platform and first used in the spring 2016 semester" [Polachowska K., 2019]. A little experiment was run when Georgia Tech introduced Jill into their course: the students were not told which teaching assistant would be assigned to them – whether human or AI. Two 'Jills' named 'Stacy' and 'Ian' worked alongside 13 human teaching assistants. In a piece of writing from January 2017, they described this test and their observations on virtual assistant (teacher) activity. "At the end of the semester, students were polled about who was human and which teacher assistant was AI. A little over 50% of them guessed that Stacy was AI and 16% named Ian as non-human. About 10% of the students thought that 2 of the human teacher assistants were not real. Virtual teaching assistants as illustrated by Jill were recently recognised as one of the most transformative technologies to impact college within the past 50 years by the Chronicle of Higher Education" [Maderer J., 2017].

Machines with human-level intelligence are on the horizon. Whether they will be conscious remains science-fiction. Why? Even the most sophisticated brain simulations are unlikely to produce conscious feelings. It is worth mentioning the words of spiritual leader Sadhguru Jaggi Vasudev, founder of Isha Foundation: "Alertness and consciousness are what will make a person superior, as artificial intelligence takes up the task of remembering and carrying information" [The Times of India, 2019].

## 2.9. Massive Open Online Courses

**A Massive Open Online Course (MOOC) is an online course geared towards limitless participation, and it is freely accessible through the web** [Kaplan A. M., Haenlein M., 2016] "with a publicly shared curriculum and open-ended outcomes" [McAuley A. et al., 2010]. To support community interaction among students, teaching assistants and professors, many MOOCs offer interactive user fora. MOOCs may be associated with a wide range of "technology-enhanced learning, including concepts such as e-learning, blended/hybrid learning and various understandings of online learning". Due to these varying originalities and similarities to several associated technology-improved learning activities, the complexity of defining a MOOC has been highlighted by researchers [Siemens G., 2012; Bates T., 2014; Read T., Rodrigo C., 2014; Tømte C., Fevolden A. M., Olsen D. S., 2014].

Even if there are numerous understandings and translations of what constitutes MOOCs, these continue to be poorly described. They can be interpreted in several approaches and modified to a country's existing educational systems. However, Jansen and Schuwer put forward that "one central approach has gained ground in Europe: MOOCs are online courses designed for a large number of participants, that can be accessed by anyone anywhere as long as they have an internet connection, are open to everyone without entry qualifications, and offer a full/complete course experience online for free. This definition includes interpretations of the MOOC abbreviation in that 'online courses designed for a large number of participants' constitutes the 'M' (Massive); accessed by anyone anywhere as long as they have an internet connection, the 'O' (Online): open to everyone without entry qualifications, the 'O' for

(Open); and complete course experience online for free, which the 'C' (Courses) stands for" (Figure 26) [Jansen D., Schuwer R., 2015].

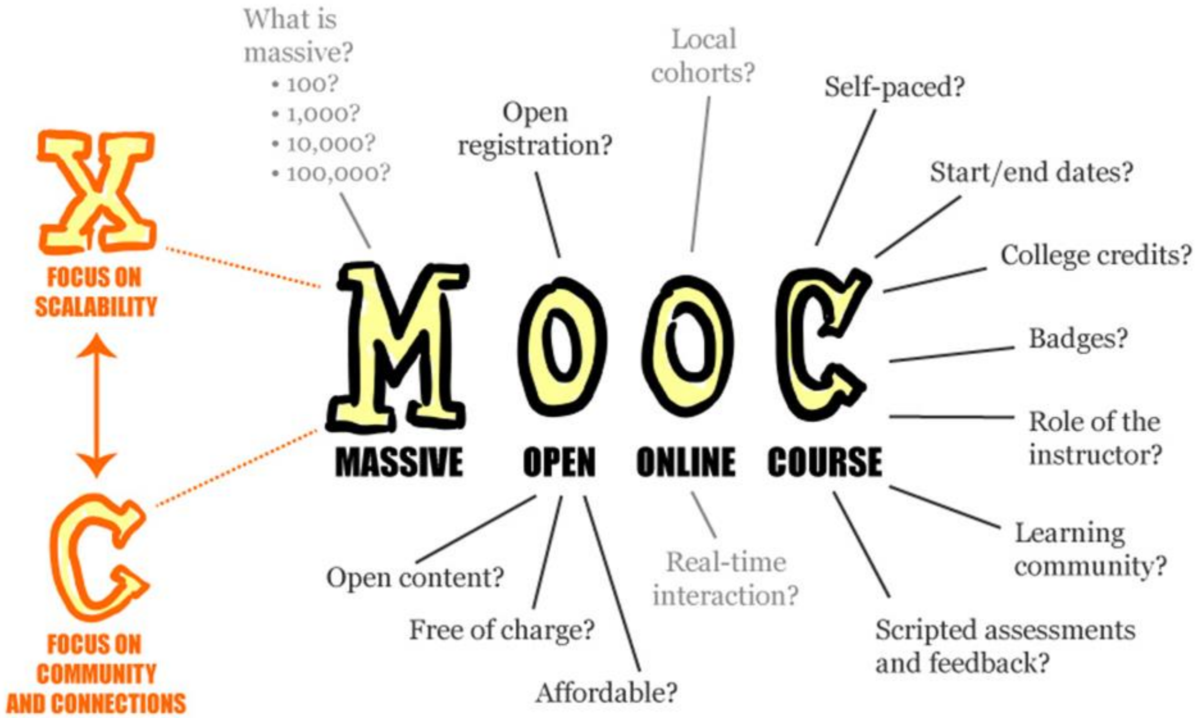



Figure 26. Meaning of 'Massive Open Online Courses' aka MOOCs [Plourde M., 2013].

MOOC integrates the interconnectivity of social networking, the facilitation of a professional in an area of study, and a set of online resources that are freely accessible. **MOOCs are based on the active involvement of hundreds to thousands of learners who self-organise their participation based on learning objectives, existing knowledge, abilities and shared interests.** There are often no costs, no requirements other than an Internet connection and interest, no predetermined participation objectives and no formal accreditation (Figure 27) [McAuley A. *et al*., 2010].

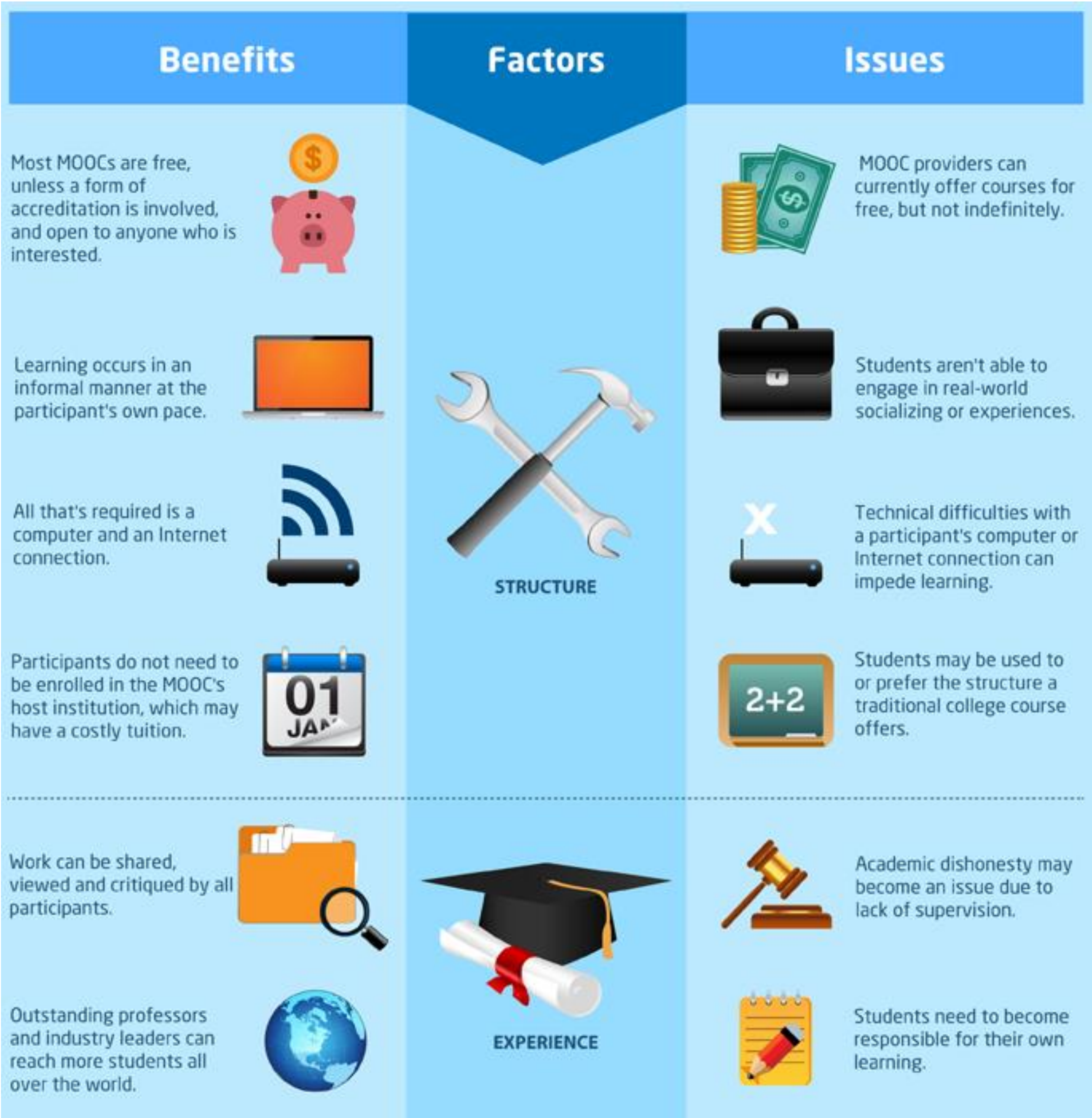



Figure 27. General characteristics of MOOCs [Hopkins D., 2013].

Though MOOCs originated from North American universities [Rodriguez C. O., 2012; Waldrop M., 2013], they do not form part of the formal academic course offering and are provided through digital platforms such as Coursera, Udacity, edX, MiriadaX, and the likes, which were created for this purpose [Yuan L., Powell S., 2013; Pang Y., Wang T., Wang N., 2014; Ong B. S., Grigoryan A., 2015]. In Table 7, there is an evaluation of four famous MOOC platforms [Hamoud Y. A., 2018].

Table 7. Comparison of MOOC platforms [Hamoud Y. A., 2018].

| Criteria | Coursera | Udemy | Udacity | Edx |
|---|---|---|---|---|
| Organisation type | for-profit | for-profit | for-profit | non-profit |
| Partnerships | universities, organisations | individual instructors, marketing affiliates | corporations, universities | schools, universities, non-profit organisations, corporations |
| Free courses | ✔ | ✔ | ✔ | ✔ |
| Paid courses | ✔ | ✔ | ✔ | ✔ |
| Completion certificates | paid verified certificates | depends on the course | only for paid courses | paid verified certificates |
| Self-paced courses | ✔ | ✔ | ✔ | ✔ |
| Scheduled courses | ✔ | x | x | ✔ |
| Discussion forum | ✔ | ✔ | ✔ | ✔ |
| Mobile apps (Android, iOS) | ✔ | ✔ | ✔ | ✔ |
| Assessment methods | quiz, uploaded assignment, peer review, projects | quiz, coding exercises | quiz, coding exercises, projects | quiz, uploaded assignment, peer review, projects |

Some studies present the role played by universities in the MOOC phenomenon to be the outcome of the technology-media convergence system and the result of the lowering standard of higher education within the framework of the reduction in cultural diversity because of globalisation [Yuan L., Powell S., 2013; Daniel J., Vásquez E., Gisbert M., 2015]. Other academics see MOOCs as an opportunity for public institutions with lower finances, rather than a threat, highlighting its advantages in reaching social groups like pensioners and employees who want to enhance their technical skills [Ong B. S., Grigoryan A., 2015]. They are observed as a possibility to boost lifelong learning [De Freitas S. I., Morgan J., Gibson D., 2015], a perspective that European institutions share, which recollects them to be a game-changer in higher education [European Commission, 2013; European Parliament, 2015].

Two features have set the MOOCs other than the already well-hooked up e-learning industry: massiveness and openness [Atenas J., 2015]. "However, these basic principles of openness, reuse and recombination" [OECD, 2015] have been obscured. The providers ought to now and then upload costs of extra services, inclusive of accreditation and certification [Daniel J., Vásquez E., Gisbert M., 2015; Atenas J., 2015]. It results is in the criticism that relates the boom of the MOOCs with financial and business profit [Ospina-Delgado J. E., Zorio-Grima A., García-Benau M. A., 2016].

The development of MOOCs has been acknowledged as one of the disruptive innovations in training [Jacoby J., 2014]. It is thought that the technological advances in better schooling are no longer overly seen till the emergence of those courses [Sursock A., 2015], "the rise of which since 2012 has been the subject of great debate in today's educational and pedagogical field" [Ng'ambi D., Bozalek V., 2015; Sangrà A., González Sanmamed M., Anderson T., 2015]. Due to the sheer value of the MOOC phenomenon, many experts agreed that MOOCs might transform education [Mazoue J. G., 2013; Gaebel M. *et al*., 2014; Schuwer R. *et al*., 2015].

The first MOOCs appeared from the open educational resources movement. "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'). 'CCK08', which was led by George Siemens of Athabasca University and Stephen Downes of the National Research Council, consisted of 25 tuition-paying students in Extended Education at the University of Manitoba, as well as over 2,200 online students from the general public who paid nothing" [Parr C., 2013]. All course material was accessible via RSS feeds, and online students could interact using collaborative technologies such as blog posts and threaded conversations in Moodle and Second Life sessions [Downes S., 2008; Cormier D., 2013(a); Cormier D., 2013(b)].

Hollands and Tirthali studied why establishments provide MOOCs, with a study of 83 interviews with leaders of 29 US institutions. They identify six primary objectives: "**1) expanding the institutional scope and attracting a larger number of students (size), 2) building and maintaining their brand (prestige), 3) improving their finances by reducing costs or increasing income, 4) improving their educational results, 5) innovating in**

**teaching-learning and 6) conducting research on teaching and learning processes"** [Hollands F. M., Tirthali D., 2014]. For the time being, the study by Jansen et al., based on online surveys of 67 institutions of higher education in 22 European countries that either offer MOOCs or planned on doing so indicated that the most crucial goal, unlike in the United States, is to **provide new chances for flexible learning**. It also revealed that "the number of European universities offering MOOCs or that plan to do so increased from 58% in 2013 to 71.7% in 2014" [Jansen D. *et al.*, 2015]. In contrast, in the U.S., according to the data from Allen and Seaman, it decreased from 14.3% to 13.6% [Allen I. E., Seaman J., 2015]. Therefore, it was concluded by Jansen and others that European universities appear to be more dedicated to MOOCs than their U.S. counterparts [Jansen D. *et al*., 2015].

The growing reputation of MOOCs as a recent and effective medium to get access to knowledge has fostered a lot of debate in higher education. Some authors are worried about the subject of the low quality of their instructional materials [Margaryan A., Bianco M., Littlejohn A., 2015] or their excessive dropout rate [Onah D. F. O., Sinclair J., Bollat R., 2014], whilst others highlight the diverse research challenges prompted by the massive scale feature [Dillenbourg P. *et al*., 2014]. Some of these issues have to do with encouraging social interactions that might lead to knowledge generation [Manathunga K., Hernández-Leo D., 2015] or the improvement of current pedagogical methods which benefit from the large scale [Sharples M. *et al*., 2015].

Though cMOOC (constructivist) has been present since 2008, the xMOOC became the 'buzzword' ever since 2012 due to the emergence of Coursera, Udacity and edX. Consequently, The New York Times called 2012 "the year of MOOC" [Pappano L., 2012]. Since then, countless MOOC courses and platforms have been launched.

Even though most of the courses offered in MOOCs are free, certificates are got for a bit of a token. **Short films, quizzes, peer-based or self-assignment, and online forums are all standard features of MOOCs** [Glance D. G., Forsey M., Riley M., 2013]. However, courses' pedagogical variations exist even within the same learning platform [Bali M., 2014]. Offering or taking a MOOC has advantages for both parties; however, questions about the actual value of MOOCs are being raised. It is partly because MOOCs have a higher dropout rate, with only 7-13% passing the courses, and sometimes even fewer [Jordan K., 2014]. **A significant difficulty for online education providers is the high dropout rate in most MOOCs** [Mamman B. *et al*., 2017]. Short videos, online quizzes and assessments, peer evaluation, and a discussion forum are all components of MOOCs that are intended to inspire and increase students' learning. [Tseng S. F. *et al*., 2016].

Alternatively, MOOC students benefit more than those who take a class on campus, according to some research [Colvin K.F. et al., 2014]. Simultaneously, some researchers are uncertain whether actual learning really happens in a MOOC [Daniel J., 2012]. The effectiveness of quality factors for e-learning is proved with empirical evidence. However, those factors are not suitable for a MOOC because of its unique features [Yousef A. F. *et al*., 2014].

A study at Stanford University examined various levels of engagement among the participants from three different MOOCs. The result of the study revealed that "there were typically four different types of MOOC learners engaging with a course: Completing, Auditing, Disengaging and Sampling learners" [Kizilcec R. F., Piech C., Schneider E., 2013]:

- **Completing**

  MOOC Learners who complete most of the assessments offered in the class.

- **Auditing**

  MOOC Learners who simply watch video lectures.

- **Disengaging**

  MOOC Learners who take part in assessments at the start but disengage within the first three weeks of the course.

- **Sampling**

  MOOC Learners who watch video lectures for only one or two periods of assessment.

Students come to a course from various backgrounds and motivations. Therefore, it may be acceptable to have not only completing learners but also other types of learners who can be classified as "auditors" or "non-completing", whose needs should be addressed through adaptive course features to make the learning experience more flexible for them [Yeşil D., 2014].

Conversely, "completing MOOC learners" participate the most in the forum discussions. This appears to be an essential finding since social behaviour in a particular course seems to be distinctly correlated with the commitment to finishing such a course [Yeşil D., 2014].

The significance of building a personal relationship, besides a professional one, has been connected to small online and face-to-face classes where the group boundaries are fixed. "However, there remains a significant challenge in leveraging the benefits of such interpersonal relationships in large learner cohorts, particularly in non-formal contexts. In massive open online courses, learner participation in social activities is intermittent" [Yang D. *et al*., 2013], and early relations can build up to a stage of pandemonium [Brinton C. G. *et al*., 2013] that hampers the propensity of an individual for developing relationships. For example, according to Gillani and Eynon, MOOC fora "assemble and disperse as crowds" [Gillani N., Eynon R., 2014]. Furthermore, Poquet and his colleagues stated that "the relatively short time frames associated with MOOC offerings also further diminish the opportunities for learners to develop interpersonal trust" [Poquet O. *et al*., 2018]. The following militate against the development of the MOOC community: the enormous course volume, short period of teaching and the non-formal nature of MOOCs. "In such instances, the use of established instruments evaluating if learner-learner bonds have been forged becomes irrelevant" [Poquet O., Dawson S., Dowell N., 2010].

The support of associations between learners, concepts and artefacts is favoured through networked learning, connectivist and socio-material approaches [Jones C., 2004; Siemens G., 2004; Bell F., 2011]. For example, "a connectivist approach to teaching in networked systems includes controlling the network of learners through a facilitating role – by amplifying, curating, way-finding and socially-driven sense-making, aggregating, filtering, modelling and being persistently present" [Siemens G., 2008]. In this context, the instructor's responsibility becomes associated with the promotion and facilitation of the interconnectedness of the network [Poquet O., Dawson S., Dowell N., 2010].

One of the outcomes of social networking sites and a few apps, which have turned out to be nearly the focus of our lives in many ways, is that individuals have a growing tendency towards too much public sharing and interactivity in their environments. A number of these online tools/apps are both spontaneous and addictive and tap into people's yearning (social tendency) to "show off to the rest of the world. (…) How this kind of social tendency 'to be recognised' by others can be used in online learning without losing sight of pedagogy? Some platforms like the Australian MOOC platform Open2Study already utilise some techniques such as badges to motivate learners" [Yeşil D., 2014].

"MOOCs offer free courses, competence development and certification. They are often considered the promised land of education, democratising education through scalable technology". Being a "stand-alone" solution, MOOCs make available occasions for not only reflecting on but also constructing new knowledge; nevertheless, they frequently involve the smallest amount of live interaction. Many MOOCs are still an online imitation of traditional classrooms, for the most part made up of video lectures, questions and answers, multiple-choice quizzes and other informal "after-class discussions in online discussion forums" [Noesgaard S. S., Ørngreen R., 2015].

Noesgaard and Ørngreen pointed out some aspects related to MOOCs: "So are MOOCs ineffective because little interaction is provided compared to face-to-face teaching? And if not, is interaction not a key factor in e-learning effectiveness?" The importance of interaction in learning retention and transfer is undeniable. A deliberate place for reflecting on practice and empathetic customisation of the subject matter can be provided by an educational design that incorporates "collaboration and interaction with peers and a facilitator" [Noesgaard S. S., Ørngreen R., 2015].

MOOCs have created good possibilities for educators and researchers who are curious about getting to know analytics. Educators have access to massive data sets of students' online learning interactions because of the large number of learners that engage in MOOCs. Large amounts of educational data may be used to build a better understanding of students' online behaviours, engagement patterns, and learning outcomes [Coffrin C. *et al*., 2014].

While MOOCs are not a panacea for the educational system's flaws, they do pose significant challenges for educational communities in terms of rethinking teaching-learning processes in the context of a constantly changing society [Ospina-Delgado J. E., Zorio-Grima A., García-Benau M. A., 2016].

### 2.9.1. Massive Open Online Courses for Training of Public Servants

When one considers the sheer number of public employees who require ongoing training at the local, regional, and national levels, which would normally be provided face to face or in a traditional e-learning environment, using MOOCs for the public sector is not just a viable option to consider; it is a requirement. However, to reach this vast number of government personnel in less time and at a lower cost, while preserving quality, the training method should be reconsidered to avoid sacrificing quality in the pursuit of quantity [Sanchez-Gordon S., Calle-Jimenez T., Luján-Mora S., 2015].

Figure 28 illustrates the homepage of a MOOC for public servants 'Introduction to the Economics of Public Services Regulations' delivered by Université libre de Bruxelles.


Figure 28. Massive Open Online Course "Introduction to the Economics of Public Services Regulations" by Université libre de Bruxelles [ECARES, 2015].

### 2.9.2. MOOCs in Public Servants' Training – Case Studies

Singapore

In 2018, the Singaporean government declared that public officials would have entry to online classes. Training will be provided by institutions of higher education in Singapore coupled with providers of online services with over 2,500 courses to choose from. At the launch time, the platform will offer timely educational resources to enhance upskilling, such as digital literacy. Besides e-learning, the platform will connect officers across the entire public service, “facilitating cross-agency social and peer-learning, and creating a more connected government in the process” [Bickham M. A., 2018].

### Latin America and the Caribbean Region

The first international organisation to offer MOOCs in Latin America and the Caribbean Region was the Inter-American Development Bank (IDB) (the first quarter of 2014). It partnered with edX and was funded by Harvard University and Massachusetts Institute of Technology. IDB established IDBx and protracted its provision of face-on and e-learning courses to a larger audience of public servants. IDB experts organised the first three IDB MOOCs, and upcoming ones are created in collaboration with top American universities [BID, 2014].

### Ecuador

In February 2014, the Ecuadorian National Institute of Advanced Studies (IAEN) executed its own MOOC platform known as FORMAx (previously UPEx), based on Open edX. The IAEN aims to render massive online education with little or zero cost for citizens. FORMAx, as per IAEN, will transform the training of multitudes of public sector personnel across the country, at a much lower price and with an infinite reach, in themes such as structure and functioning of the state, legal frameworks, and instruments used in public administration [Ruiz L., 2014].

The first MOOC offered by IAEN is “Constitution for Public Employees” (CNE02). The course has been developed to assist public employees in Ecuador in gaining knowledge of the general guidelines and issues of the Political Constitution adopted in 2008. “This MOOC is supported by a certificate issued by the Continuing Education Center (CEC) of IAEN valid throughout Ecuador and other countries. CNE02 started in November 2014. It is a five-week course with ten hours per week commitment” [IAEN, 2014].

### Open Online Academy

The Open Online Academy (OOA) initiated its "Open edX based" Massive Open Online Course platform in November 2013. In October 2014, they provided the course 'Introduction to GIS and its Application to the Management of Natural Disasters' in collaboration with the University Network for Architectural and Urban Sustainability from Spain. Global natural disasters have become more common due to climate change, one of the critical issues discussed in this course. The MOOC examines the consequences of climate change in many parts of the world and the use of GIS technology to manage natural catastrophes. It is intended for public servants, the private sector, and community organisations [OOA, 2014].

International Monetary Fund

The International Monetary Fund announced a partnership to utilise the edX platform to provide courses in economics to public officials of 188 countries in June 2013. The IMF maintains 8 training centres worldwide, where thousands of central banks, finance ministries, and other professionals attend courses each year. The Fund used the MOOC concept to reach a broader audience and promote a better grasp of economic policy concerns [IMF, 2013].

The earliest course provided by the International Monetary Fund was FPP.1x "Financial Programming and Policies: Macroeconomic Accounts and Analysis", delivered in June 2014. The course lasts for six weeks with a commitment of eight hours each week. Two more courses were provided in October 2014: ESRx "Energy Subsidy Reform" and DSAx "Debt Sustainability Analysis" [IMF, 2014].

### 2.9.3. Challenges and Strategies for Successful Use of MOOCs in Public Sector Training

There are some obstacles to overcome to increase the usage of MOOCs for public sector training. In this section, I present strategies to address three of them: **enrolment, completion, and web accessibility.**

**Enrolment**

The total number of people that sign up for a course is known as the enrolment rate. Although some MOOCs have attracted up to 370,000 students (edX's "Circuits and Electronics", the largest MOOC to date [Pappano L., 2012]), a typical university-led MOOC enrolment ranges from 20,000 to 230,000 students, with most courses falling below 100,000 participants [Stevanović N., 2014]. However, it is essential to take into account behaviours in MOOC registrants to interpret these huge enrolment numbers correctly. According to Milligan and others, one can distinguish here [Hill P., 2013; Milligan C., Littlejohn A., Margaryan A., 2013]:

- ✓ "No-shows, people who enrol but never log in once the course opens. This could be as much as 50% of enrolment".
- ✓ "Lurkers, people who enrol, but just to observe or sample a few items at the most. Many of these participants do not complete week 1".
- ✓ "Drop-ins, students who become active participants only for a select topic within the course (…). Some of these students are participants who use the MOOC to meet external goals".
- ✓ "Passive participants, students who view a course as content to consume and expect to be taught. These students typically watch videos, perhaps take quizzes but tend to not participate in activities or class discussions".
- ✓ "Active participants, students who intend to fully participate and complete the MOOC, including consuming content, taking quizzes and exams, taking part in activities such as writing assignments and peer grading, and actively participate in discussions via discussion forums, blogs, and social networks".

Firmly stated, "drop-ins", "no-shows" and "lurkers" should not be included in the rate of enrolment. Increasing the number of public sector personnel enrolled in MOOCs would enable the government to achieve its aim of enormous training at a minimal cost to the government and no cost to the participants. The following initiatives may be adopted to increase the number of public sector personnel enrolled in MOOCs [Sanchez-Gordon S., Calle-Jimenez T., Luján-Mora S., 2015]:

- Provide free preliminary tutoring in building digital literacy skills and becoming an independent learner. This is important because some personnel in the public sector lack the essential abilities to use information and communication technology. This might also help reduce the stress that comes with starting a new endeavour [Davis H. *et al.*, 2014].

- Use a variety of channels to promote the MOOC, including national and local government communication platforms, social media, and human development agencies.
- Provide course content that is of great interest to public employees to improve their knowledge in the workplace.
- Provide training in the employees' native language.
- Depending on the needs of the institution, make specific courses mandatory.
- Subsidise the cost by keeping the MOOC free for government employees and low for the government.
- Within the workplace, incentives should be provided.
- Obtain valid completion certificates from the sponsoring organisation/institution [Davis H. *et al.*, 2014].
- Highlight extra advantages for public servants, such as enhancing their expert network and becoming members of a social learning community [Milligan C., Littlejohn A., Margaryan A., 2013].

**Completion**

Completion rate is defined as "the proportion of enrolled participants who earn a certificate of completion". As Jordan states, although some MOOCs have a completion rate of 40%, the current average MOOC completion rate is about 13% [Jordan K., 2014]. Since there are regularly many thousand registrants in a MOOC, this typical completion rate nevertheless translates to an excessive range of members finishing the course. It is critical to enhance completion rates in public administration to make sure that employees' training objectives are accomplished.

The following techniques may also increase the completion of MOOCs among public servants [Sanchez-Gordon S., Calle-Jimenez T., Luján-Mora S., 2015]:

- Working people, especially those in the public sector, find it challenging to commit to an 8 to 12-week course, which is the standard for university-led MOOCs. MOOCs with shorter durations, such as two to six weeks, will have higher completion rates [Pappano L., 2012].
- Maintain your weekly time commitment between 2 and 6 hours.

- Deliver Internet connection so that employees may take the course at work.
- Create an easy-to-understand syllabus.
- Create a social learning community.

**Web Accessibility**

Sanchez-Gordon and Luján-Mora defined web accessibility as “the capacity of web content to be accessed and used by both disabled and non-disabled users” [Sanchez-Gordon S., Luján-Mora S., 2013]. Also, people with disabilities can see, comprehend, navigate, and engage with the web and contribute to its content, thanks to web accessibility [W3C, 2012]. According to a 2011 United Nations Report, “more than one billion people live with some form of disability” [WHO, 2011]. The United Nations Convention of the Rights of Persons with Disabilities recognises “the right of people with disabilities to work, on an equal basis with others; and promote the employment of individuals with disabilities in the public sector” [United Nations, 2008]. Based on this, numerous states have legal guidelines that put in force the inclusion and labour safety of humans with disabilities within the public sector. Hence, MOOCs used for training in the public sector must have adequate levels of accessibility.

The following techniques can enhance the accessibility of MOOCs [Sanchez-Gordon S., Calle-Jimenez T., Luján-Mora S., 2015]:

• Construct the MOOC following online accessibility standards such as WCAG 2.0, including spatial data accessibility.

• Using automated technologies such as ACheker, eXaminator, TAW, TotalValidator, and WAVE, assess the level of accessibility of MOOC websites [Calle-Jimenez T., Sanchez-Gordon S., Luján-Mora S., 2014].

• Evaluate the MOOC’s accessibility with specialists and users with various sorts of disabilities.

**MOOCs have the potential to play a significant role in teaching public sector personnel due to their large size and reasonable cost.** MOOCs can be used by regional organisations, national governments, and municipalities to train public servants in a mass and high-quality manner. MOOCs have the potential to assist states lower unemployment rates by providing training and skills development. In this regard, France announced in May 2015 that it would offer jobless citizens access to MOOCs on the OpenClassrooms platform, along with certificates of completion [OpenClassrooms, 2015].

MOOCs on government themes and spatial data management can increase the social involvement of both public personnel and local citizen groups interested in local government decisions. The adequate training of staff in public institutions for the production of geographic projects is a vital component in helping unify criteria in analysing and developing geographic maps to assist decision making. MOOCs must be made available to teach more government officials about spatial technology. As a result, they will better manage geographic data and make judgments that will not harm the public or the environment [Sanchez-Gordon S., Calle-Jimenez T., Luján-Mora S., 2015].

## 2.10. Blended Learning

Blended Learning is "an **education programme that combines online digital media with traditional classroom methods.** It requires the physical presence of both teacher and student, with some element of student control over time, place, path or pace" [Friesen N., 2012; Staker H., Horn M. B., 2012; eLearning Infographics, 2014; Banditvilai C., 2016]. While students nonetheless attend classes in the presence of a teacher, face-to-face practices are mixed with computer-mediated activities concerning content material and delivery [McGee P., Reis A., 2012; Strauss V., 2012]. Blended learning is utilised in professional development and training [Lothridge K., Fox J., Fynan E., 2013].

Figure 29 and Figure 30 present visually essential characteristics of blended learning [Cedar Ridge Academy, 2020; Hsiung W. Y.].

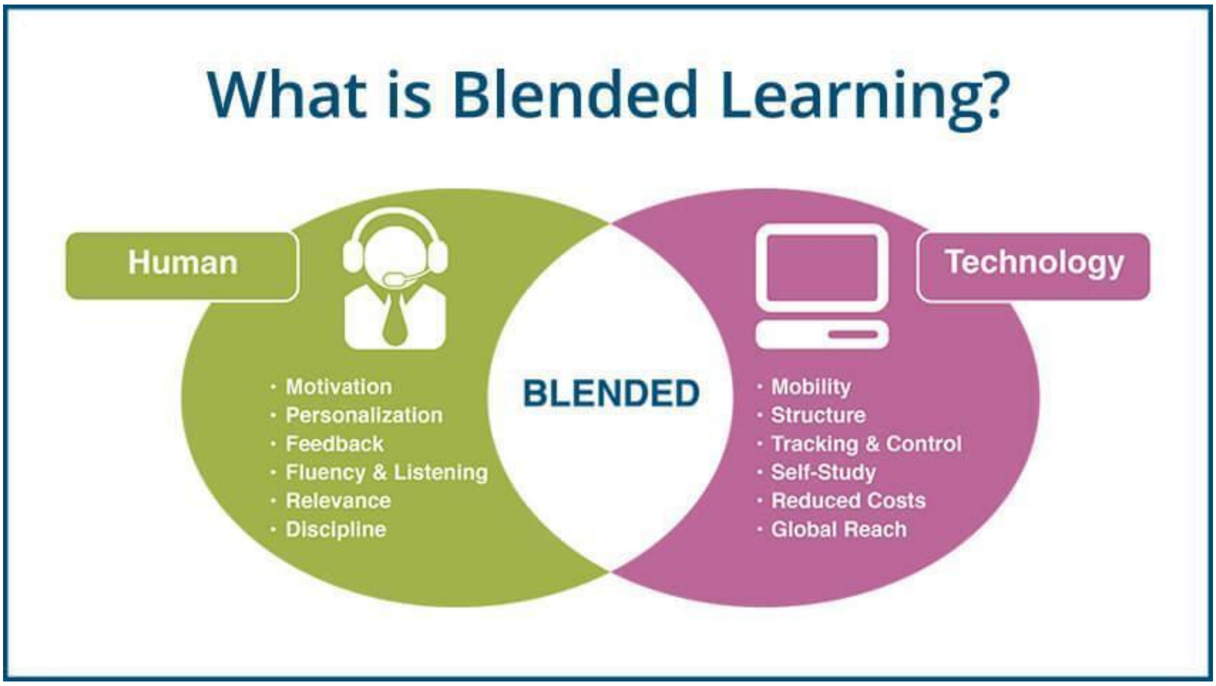



Figure 29. What is blended learning? [Cedar Ridge Academy, 2020].

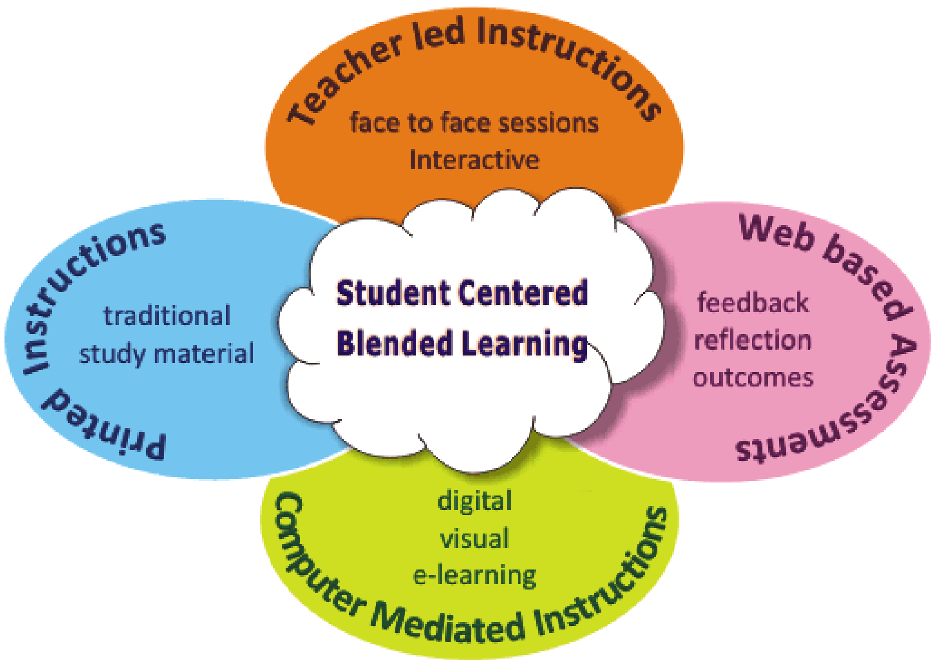



Figure 30. Essential elements of blended learning [Hsiung W. Y.].

Although the principles of blended learning were established in the 1960s, it was not until the late 1990s that the official term took shape. In a 1999 news release, Interactive Learning Centers, an Atlanta-based education company, announced a name change to EPIC Learning, one of the first usage of the word emerges. The release mentions that: “The Company currently operates 220 online courses, but will begin offering its Internet courseware using the company’s Blended Learning methodology” [The Free Library, 1999]. Initially, the term blended learning was vague and encompassed various technologies and pedagogical methods in different combinations. With the publication of Bonk and Graham’s first Handbook of Blended Learning in 2006, the term “Blended Learning” became more precise. Graham challenged the vagueness of the “definition of the term” and defined blended learning systems as “learning systems that combine face-to-face instruction with computer-mediated instruction” [Bonk C. J., Graham C. R., 2006]. In a report titled “Defining Blended Learning”, researcher Friesen suggests that blended learning refers to the variety of possibilities opened up by merging the Internet and digital media with traditional classroom formats that need an instructor and student physical attendance [Friesen N., 2012]. Platforms such as the Khan Academy serve for blended learning [Khan Academy, 2012].

Some researchers and educational groups of experts made suggestions for several blended learning models. These include:

**face-to-face driver** –the tutor guides the lesson and augments it with virtual tools [DreamBox Learning, 2013],

**rotation** – students go through a schedule of face-to-face lectures and online classes [DeNisco A., 2014; Kim A., 2014],

**flex** – a greater portion of the curriculum is conveyed online while the face-to-face session with a teacher is used for consultation and support [Kharbach M., 2014],

**labs** – the whole course is delivered digitally but in the exact physical location; usually, conventional classes are also taken by students in this model [Connections Learning, 2014],

**self-blend** – students choose to reinforce their traditional style of learning with online learning [DreamBox Learning, 2013],

**online driver** – “students complete an entire course through an online platform with possible teacher check-ins” [Aspire Public Schools, 2013]; face-to-face gatherings are scheduled only when necessary; thus, all course work and teaching are virtually delivered [Idaho Digital Learning, 2014].

It is worth noting that blended learning models may be combined, and many implementations employ a combination of them as part of a broader blended learning strategy [Beaver J. K., Hallar B., Westmaas L., 2014].

Banditvilai stated that “many components can comprise a blended learning model, including instructor-delivered content, e-learning, webinars, conference calls, live or online sessions with instructors, and other media and events, for example, Facebook, e-mail, chat rooms, blogs, podcasting, Twitter, YouTube, Skype and web boards” [Banditvilai C., 2016].

Stricker, Weibel and Wissmath, who surveyed blended learning, compared two categories of students: “a group with the support of e-learning” and “a group without contact with it”. The results showed that the students who were in favour of e-learning performed better than those who preferred face-to-face learning only [Stricker D., Weibel D., Wissmath B., 2011].

### Advantages of blended learning

**Blended learning has been reported to be more effective than entirely online or entirely face-to-face learning** [de Guia S., 2015]. Blended education systems can produce high levels of student performance better than onsite education [Saritepeci M., Cakir H., 2015]. Using a combination of campus-based and digital instruction, students can work independently with novel ideas that free teachers up to rally around and assist individual learners who may require personal attention. “Rather than playing to the lowest common denominator – as they would in a traditional classroom – teachers can now streamline their instruction to help all students reach their full potential” [DreamBox Learning, 2013].

Advocates of blended education point out that integrating the asynchronous Internet communication technology into higher education courses helps to “facilitate a simultaneous independent and collaborative learning experience” [Garrison D. R., Kanuka H., 2004]. This is a significant factor in student satisfaction and performance in such classes. Students’ attitudes towards learning have been observed to improve when information and communication technologies are used [Alexander S., 2010]. Because of the use of information technology in classroom projects, communication between teachers and part-time students has increased, and learners could better understand their course content through the usage of “computer-based qualitative and quantitative assessment modules” [Alexander S., McKenzie J., 1998].

Blended learning has become a very conversant academic programme to render an impact in present-day classrooms. It is being utilised in schools and institutions to bring the digital world and in-class instruction together. This method allows instructors to construct flipped tasks that students may perform before and after class to understand topics better. And this is helpful since it frees up time in traditional classes to focus on expanding students’ knowledge and assisting them in attaining higher levels of learning [Bai C. A., Singh Y. C., 2019].

Also, blended instruction can lessen academic expenses, though some argue that it is intrinsically less costly than conventional classroom education [Robbins M., 2016]. Blended instruction can reduce costs by putting learning venues in the Internet space. It replaces expensive textbooks with electronic devices that learners often bring to class. e-Textbooks, which are available online, may also reduce textbook expenses [DreamBox Learning, 2013]. Promoters of blended instruction quote the opportunity for the collection of data and personalisation of learning and evaluation as two key advantages of this system [Caperton I. H., 2012]. Usually, blended instruction encompasses software that gathers student data and automatically ascertains educational progress, giving students, parents, and teachers comprehensive data. Regularly, tests are scored automatically, offering instant feedback. “Student logins and work times are also measured to ensure accountability” [DreamBox Learning, 2013]. Jacob acknowledged that schools that provide blended learning might reallocate resources to improve student success [Jacob A. M., 2011]. Chen reported that: “Students with special talents or interests outside of the available curricula use educational technology to advance their skills or exceed grade restrictions” [Chen I., 2014].

Blended learning replaces the traditional classroom paradigm, in which a teacher stands in front of the class, and everyone is expected to work at the same speed. Students may work at their own pace using blended learning [DreamBox Learning, 2013]. A classroom setting that integrates blended learning will naturally necessitate students to exhibit self-dependency and self-regulation to succeed [McGee P., Reis A., 2012]. Before adopting blended learning techniques, teachers should provide some sort of first programme orientation to help students feel comfortable navigating the various components and create a stronger feeling of independence [Banditvilai C., 2016].

A learning management system aid in developing users' experience of the online community discussion and getting their interests aroused [Heinze A., Procter C., 2006]. This Virtual Learning Environment allows academics to communicate with students without being physically there, making it a "virtual café." Many schools use this online application for online classrooms, homework, question and answer forums, and other school-related activities [Bradford P. *et al*., 2007].

Blended learning advantages are tied to the quality of the programmes being employed. Outstanding blended learning programmes are indicated by promoting student learning, successfully expressing concepts, passion for learning, effectively organising, showing respect for learners, and fairly measuring progress [Hartman J., Moskal P., Dziuban C., 2005].

**Disadvantages of blended learning**

Since blended learning is strongly dependent on technical tools, it can have a series of disadvantages in the technical aspects if not well planned. "These tools need to be reliable, easy to use, and up to date, for them to have a meaningful impact on the learning experience" [Garrison D. R., Kanuka H., 2004]. Thus, Alexander reaffirms that "IT literacy can serve as a significant barrier for students attempting to get access to the course materials, making the availability of high-quality technical support paramount" [Alexander S., 2010]. "Another aspect of blended learning that can be challenging is group work because of difficulties with management in an online setting" [Wicks D. A. *et al*., 2015].

According to Gosper and others, using lecture recording technology might cause students to lag in their studies. Only half of the students watched lecture videos regularly, as per the research carried out at four different universities. In contrast, almost 40% of the learners watched several weeks' worth of films in one sitting [Gosper M. *et al*., 2008].

Grieve and others claim that, "providing effective feedback is more time-consuming (and therefore more expensive) when electronic media are used, in comparison to traditional (e.g. paper-based) assessments" [Grieve R., Padgett C. R., Moffitt R. L., 2016]. Using e-learning platforms can consume even more time when compared to conventional methods; also, such media may not come without a cost, as service providers may charge monthly, annual or even a one-time fee.

## 2.11. Experiential e-Learning

This learning model is primarily based on cognitive processing and affords the “conceptual underpinning” for the improvement of a robust interpretation of learning. “The new model, represented as a visual metaphor and called the ‘learning combination lock’, responds to calls identified within the literature across a wide range of disciplines” [Dillon P., 2007] to tackle some ‘neglected areas’ such as **“the significance of the body in learning”** [Michelson E., 1998; Payne P., 2002; Fenwick T. J., 2003], and the critical position the “**affective plays in learning**” [Tennant M., 1997; Mortiboys A., 2002; Beard C., Clegg S., Smith K., 2007]. “The metaphor of the combination lock is used to illustrate the complexity of the many possible ingredients that may be used to unlock learning potential. A strength of the model is that there is a clear synergy between theory and practice. Pragmatic learning design questions of where (environment), what (activities), how (senses), hearts (affect), minds (cognition), and learning and change, all significantly corresponding to a consideration of **learning through being, doing, sensing, feeling, knowing and changing**” [Beard C., 2007], as a result developing the work of Heron who noted that the previous educational approach, which dates back to ancient times, focused only on intellectual, theoretical, and practical instruction. This is combined with emotional, interpersonal, and political competency in the new model. **People nowadays are learning through thinking, experiencing, and doing** [Heron J., 2001].

Increasing sensory experiences can reinforce learning. “(…) the more sensory input used, the more integrated the neural pathway becomes, allowing for enhanced learning” [Robertson I., 2000]. Moreno and others performed a test with instructional multimedia and thought that “social communication between teacher and student was often missing, thus reducing learning engagement”. After analysing an instructional video with a human face or an animated pedagogical agent, they concluded that instead of on-screen text, social dialogue boosted the student’s involvement with the information and improved learning [Moreno R. *et al.*, 2001].

It is debatable that actual learning experiences are either imitated or complemented by e-learning. Thus, by definition, e-learning is always a mediated version of real-life experience. It can never be entirely comparable to direct experiential learning [Beard C., Wilson J. P., McCarter R., 2007].

## 2.12. Cheating Prevention of Online Assessments

**It has been discussed that Information and Communications Technologies have made educational dishonesty simpler by permitting the surreptitious copying of other people's work**; however, has the extent of plagiarism in our universities indeed risen? With activities becoming more manageable, they do not necessarily turn out to be more common [Underwood J., Szabo A., 2003].

In response to the COVID-19 pandemic, most educational systems have made online learning mandatory. The transition from an on-site education environment to an "emergency" online learning mode brings with it several challenges, including limited access to resources, a lack of experience/skills, and concerns about the quality and efficacy of education. In terms of assessing learning outcomes, social distance works directly against proctoring because online testing conducted at individual homes increases the opportunities to cheat and the desire to do so [Li M. *et al.*, 2021].

e-Assessments have emerged as a widely received approach to decide if students have learned material from a course. "With the acceptance of this electronic means of assessing students, many questions arise about this method. (…) some students might cheat on an examination. It is widely known that students are often more technologically savvy than their professors (…). Understandably, given the amount of information available on e-assessments and the variety of formats to choose from, choosing to administer e-assessments over paper-based assessments can lead to confusion on the part of the professor" [Von Grunigen D. *et al.*, 2018]. Berkey and Halfond investigated cheating in online courses and discovered that an alarming 84% of the 141 students who answered their survey believed that dishonesty in online test-taking was a serious issue [Berkey D., Halfond J., 2015].

A major disadvantage of e-learning remains cheating through a variety of methods. Conducting examinations for remote learners has its challenge. Running a "closed-book" exam on-site requires an examination hall and invigilators. This may result in inconveniences that may outweigh the benefits of e-learning. For both campus-based and distance learning students, the Internet is an intriguing resource because of its potential to improve their educational experience [Jones K. O., Reid J., Bartlett R., 2006]. **Increased use of technology in the online learning environment appears to have given students more opportunities**

**for academic misconduct, with online information sharing among students making up a new and rising danger to academic assessment integrity** [Kleinke S., 2020]. Exam cheating is easier for online students than it is for on-campus students since they take assessments in their surroundings and computers. Without a video stream, learners cannot be directly monitored during evaluations. Furthermore, students taking online tests may give the test to a third party if a proper identity verification method is not in place [Tamm S., 2019].

**When a learner feels socially distant and unable to connect with his teacher and classmates, there is a higher tendency for such a student to cheat** [Gibbons A., Mize C. D., Rogers K. L., 2002]. Mastin, Peszka, and Lilly provided initial evidence that honour codes may be relatively ineffective online [Mastin D. F., Peszka J., Lilly D. R., 2009].

### 2.12.1. Methods of Cheating in e-Learning

A variety of ways whereby students cheat on an online test have been identified by researchers (Figure 31). In Watson and Scottile's study, "data were collected through a survey of 635 students' responses and students mentioned two main ways to cheat. The first was obtaining other students' work without their permission, and the second was taking passages from an article or a book directly without any citation" [Watson G., Sottile J., 2010]. Other typical forms of online cheating include impersonation, dishonest collaboration, and sharing of assignment data. [Ravasco G. G., 2012]. According to research by Razek, fabricating or falsifying a reference is another typical tactic performed by the majority of Saudi students [Razek N., 2014]. Another means students use in cheating in an online test is copying from the Internet. "Using verbatim questions in online tests helps the students in copying the items and getting the right answers from the Internet, while paraphrasing questions represents a challenge for students who wish to cheat" [Saleh A. M., Meccawy Z., 2020].

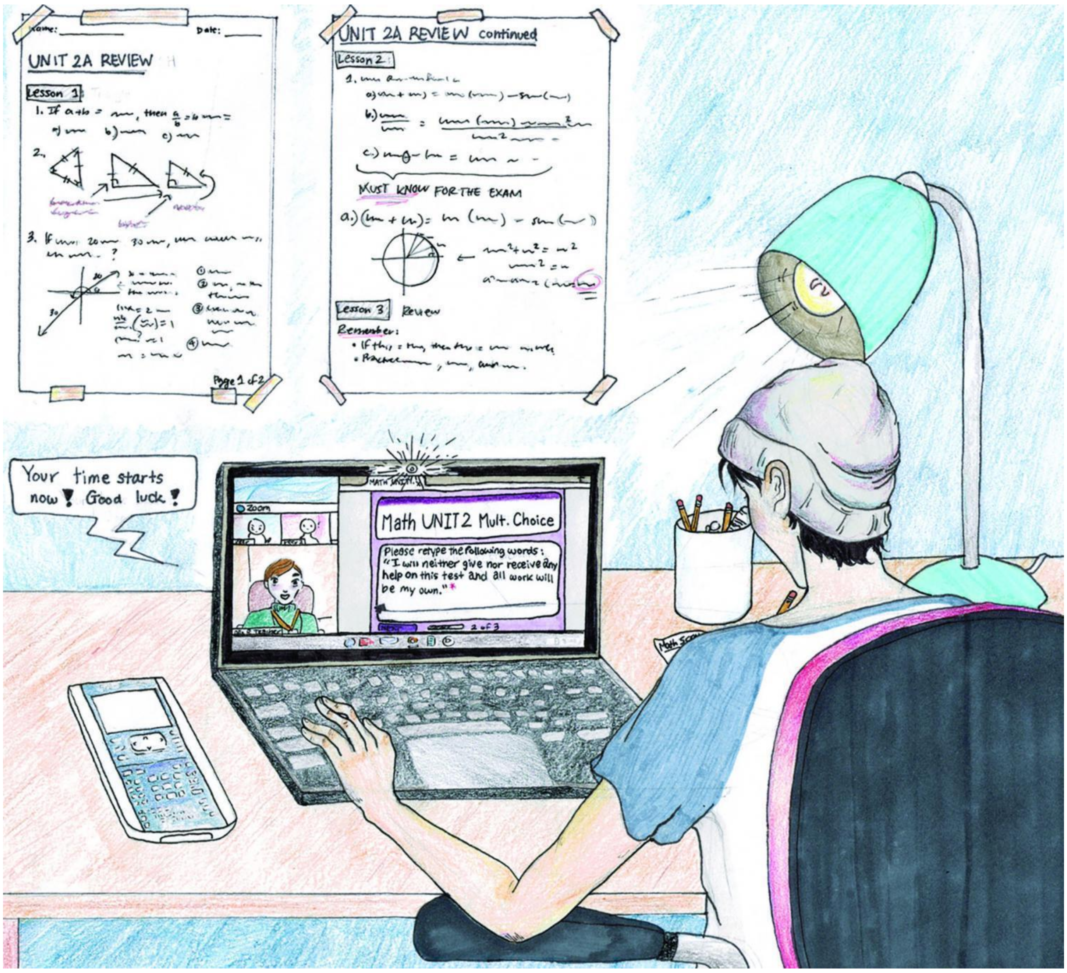



Figure 31. Students find new ways to cheat during e-learning [Yoo B., 2020].

One might suppose that during an e-learning class, a student might be impersonated by another to take the examination for him. But, simply as you would have a test proctor in a conventional classroom at some point in a check, some technologies enable online test proctoring. This is performed via software that uses technology to scrutinise your biometrics to make sure who you are. Webcams are used to monitor remote students taking exams. Keystrokes can also be detected by some Learning Management Systems (LMS) to ensure no form of copy and paste. LMS can detect a student's typing pattern. The user's IP address can be tracked to test if any other student in any other vicinity is posing as him. Together with biometric scanning that could use facial recognition or fingerprint scanning to affirm a scholar's identity, all this can make it smooth to prevent cheating in an online environment (Figure 32) [LaRock H., 2020].

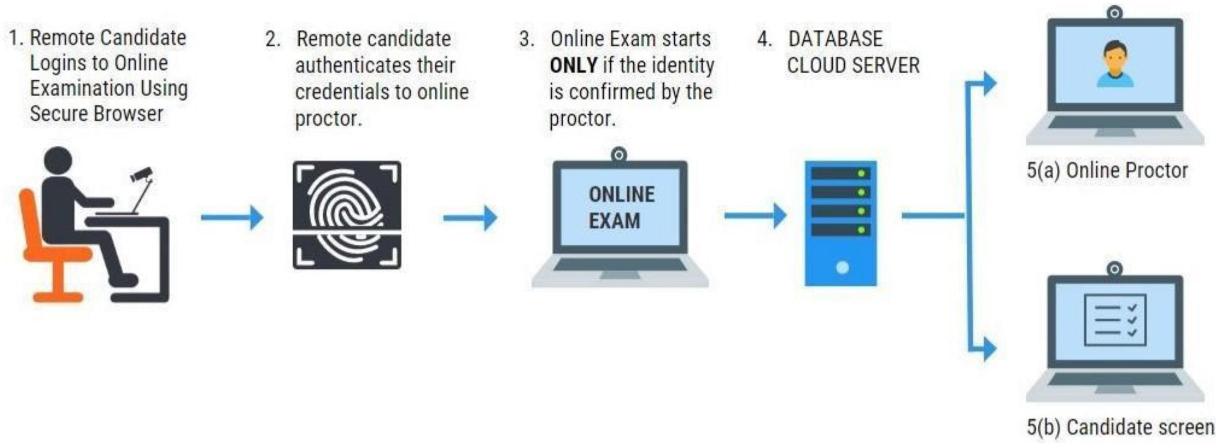



Figure 32. Remote proctoring for online examination [3E Software Solutions, 2020].

Reisman suggests universities should lock down the computers for online examination "to prevent the installation of IM clients and block e-mail services" [Reisman S., 2005]. This motion has some drawbacks. Concerning students enrolled in distance learning, one cannot tour each student's computer to ensure compliance. At the same time, the on-site or campus-based assessment affects neither IM devices, including cell phones, nor wireless computer networks. Currently, it appears that the only effective alternatives are to **prohibit the use of all electronic devices** or to deploy jamming tactics. Although the second option may seem severe, merely turning off a campus wireless network does not prevent enterprising students from setting up their wireless computer network. In addition, infrared communication between devices should be considered [Jones K. O., Reid J., Bartlett R., 2006].

Examity, a startup company based in Newton, Massachusetts, renders a handful of packages to make sure individuals being examined are who they are saying they are and they comply with the policies during the assessment. The first step is to affirm the individual's ID before the test, which calls for those taking the test to create an Examity profile and add a replica of their ID. Examity additionally gives cellular ID verification, which employs biometric authentication — including fingerprint, face recognition, and voice recognition — to validate the ID of the person taking the test. And then, there is live authentication, which is based on an actual individual to affirm the identity of the students and run through the examination regulations at the same time as examining their test environment. Customers may choose between live or automated proctoring, with the latter employing what Examity refers to as "proprietary machine learning algorithms" to detect unusual behaviour from screenshots, audio files, and video [Sawers P., 2019] (Figure 33).

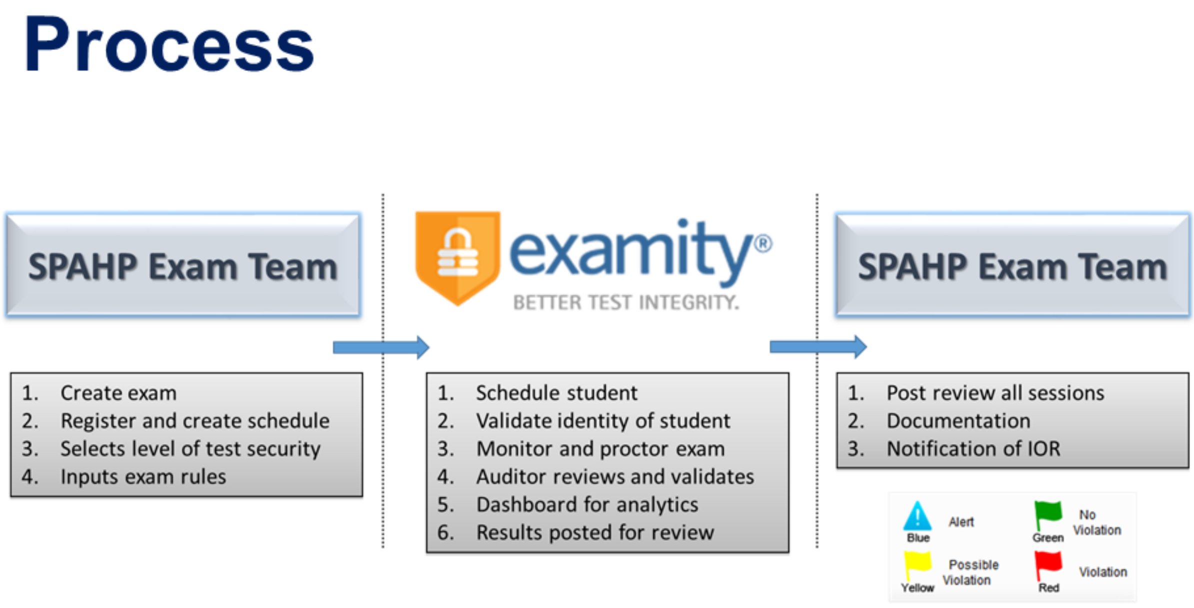



Figure 33. Examity online proctoring [Sawers P., 2019].

Dealing with an online proctor is a novel experience for millions of students and other test-takers. There is strong evidence that most of the anxiety associated with utilising a remote test observer stems from its novelty rather than the proctoring procedure itself. For example, when students take a practice test with a live proctor, some institutions have shown that discomfort and confusion decrease while satisfaction increases. One explanation for the shift in student attitudes after using proctors is that they discover that proctors may be helpful during tests. Norris outlines five ways that remote proctors might assist students in achieving their educational and assessment objectives [Norris A., 2020]:

**1. Rewarding the Honest Student**

Proctors serve an important role in ensuring that students who genuinely study and perform the work are not missed or skipped by those who take shortcuts by preventing cheating and providing everyone with an equal opportunity to demonstrate their knowledge.

**2. Test Access**

It enables students to avoid learning difficulties by allowing them to take examinations from home, in their environment, and on their own time, letting them handle medical needs, persistent allergies, phobias, and burdensome travel.

**3. Tech Issues**

Typical technical issues may be solved or navigated in real-time by live remote proctors, accelerating exam access and reducing technology hassles.

**4. The Honest Broker**

Even when you are adequately prepared, things might go wrong. The electricity goes out, children scream, animals leap on keyboards. When that happens, having a live proctor and a record of the test session may be pretty reassuring because the proctor can be an honest broker, a neutral observer who can provide evidence in favour of the test-taker.

**5. Simple Convenience**

Emergencies occur frequently. Some learners would rather take a large test before a work shift than afterwards. Others may use the additional day to study or concentrate on a different exam. Whatever the reason, taking an exam on your own time is feasible with remote test proctors who provide open access to an exam while simultaneously ensuring its integrity—guaranteeing that someone who took the test Monday morning does not copy it and pass it off to those testing on Thursday afternoon.

Some authors argue that the issue of academic dishonesty cannot be solved technologically since its roots lie in a failure to pass down valuable practices, understandings, and attitudes from one generation to the next [Townley C., Parsell M., 2004]. Others point to the difficulty of cultivating ethical behaviour in a situation where parents accept cheating in a workplace as unavoidable [Strom P. S., Strom R. D., 2007]. Also, some authors point out the complexity of ethical evaluation, as there are no negative consequences of cheating for both students and others at least soon [Björklund M., Wenestam C.-G., 1999; Colnerud G., Rosander M., 2009]. Moreover, in some cases, the moral evaluations of acceptable practices will differ for students, academics, disciplines, and assessment items, which is contextually dependent [McGowan S., 2015].

**Students' perspective**

One study from the Netherlands discovered that medical students are most concerned about unjust invalidation of their test due to an unstable Internet connection, background noise or camera difficulties, and privacy concerns. It is crucial to be aware of these issues since they might affect test findings. 597 medical students responded to the survey (35% response rate). More than half of the respondents (totally agree or agree; 59.5%) were satisfied that proctoring software would not invalidate their future online progress examinations (Figure 34a). Nearly half of the students said they were confident in the manner they would be examined for cheating (totally agree or agree; 47,4%) (Figure 34b). Although they did not cheat during their online exam, over 70% of students were concerned that their progress test would be invalidated (totally agree or agree; 69,3%). (Figure 34c). Students are most concerned about the impact of looking away from the webcam (371 students; 62,1%) and ambient noise from roommates, relatives, or neighbours (325 students; 54,4%). Another source of worry was an unsteady Internet connection (235 students; 39.4%) or a broken webcam (136 students; 22,8%). **Most respondents approved of or were neutral towards the use of proctoring in online progress test assessment (totally agree or agree: 45,2%; neutral: 31,5%)** (Figure 34).

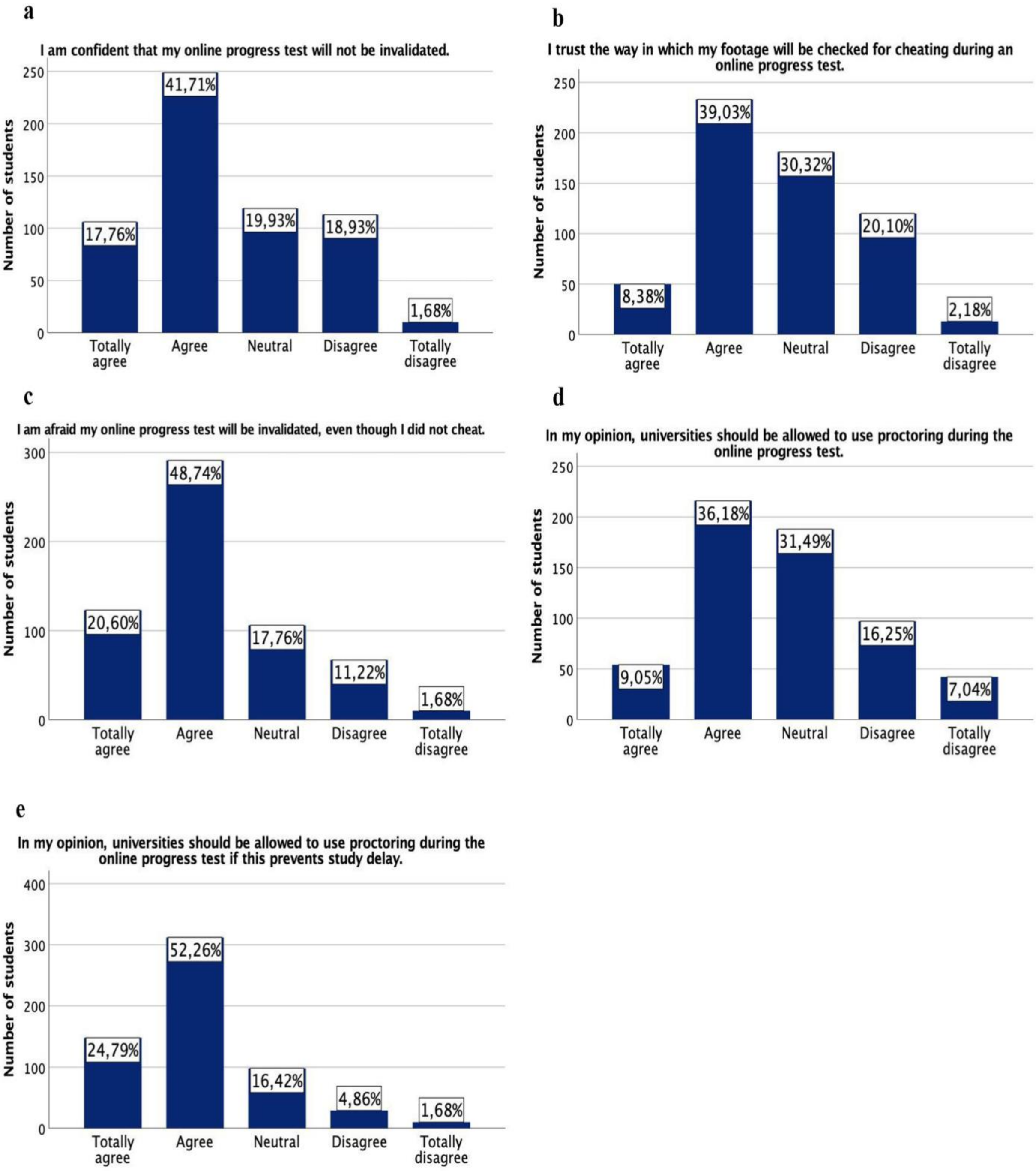



Figure 34. Medical Students' perspectives on online proctoring during Remote Digital Progress Test [Meulmeester F. L. et al., 2021].

According to a University of Wisconsin student, Examity makes testing incredibly difficult for parents. Examity requires learners to take their tests in an empty, quiet room. This was a huge challenge for the student, who lives with their two young children. "It is difficult for a non-traditional student to be alone and quiet," the student says. "I have a family in a tiny home." The student did not object, but others did; a month after introducing Examity, the professor discontinued its use [Chin M., 2020].

**The act of preventing cheating will always be more successful than the act of detecting it. Furthermore, the time and effort spent by staff in instructing students about proper academic conduct are substantially less than that required to uncover and prosecute cheating.** Subsequently, understanding students' attitudes towards failure to comply with test rules in an online learning environment is vital to both the teachers and their students [Saleh A. M., Meccawy Z., 2020].

Considering the rapidly growing application of remote learning models and related evaluation techniques in higher education [Allen I. E., Seaman J., 2017], together with a non-stop increase in technology-enabled openings geared towards examination misconduct, further studies should be conducted into the detection and prevention of cheating in online assessments [Kleinke S., 2020].

### Online Exam Proctoring Market

In the present context, online exam proctoring is fast expanding. The global online exam proctoring market is estimated to have reached USD 398.3 million in 2020. The market is further expected to touch USD 915.6 million by 202 (Figure 35). Because of coronavirus outbreaks over the world, academic institutions have been closed for months. As a result, several academic exams were cancelled or postponed. Many academic institutions and universities are attempting to develop innovative ways to finish academic years for schools, colleges, or higher education segments, which has been accomplished through online test proctoring [BlueWeave Consulting, 2021].

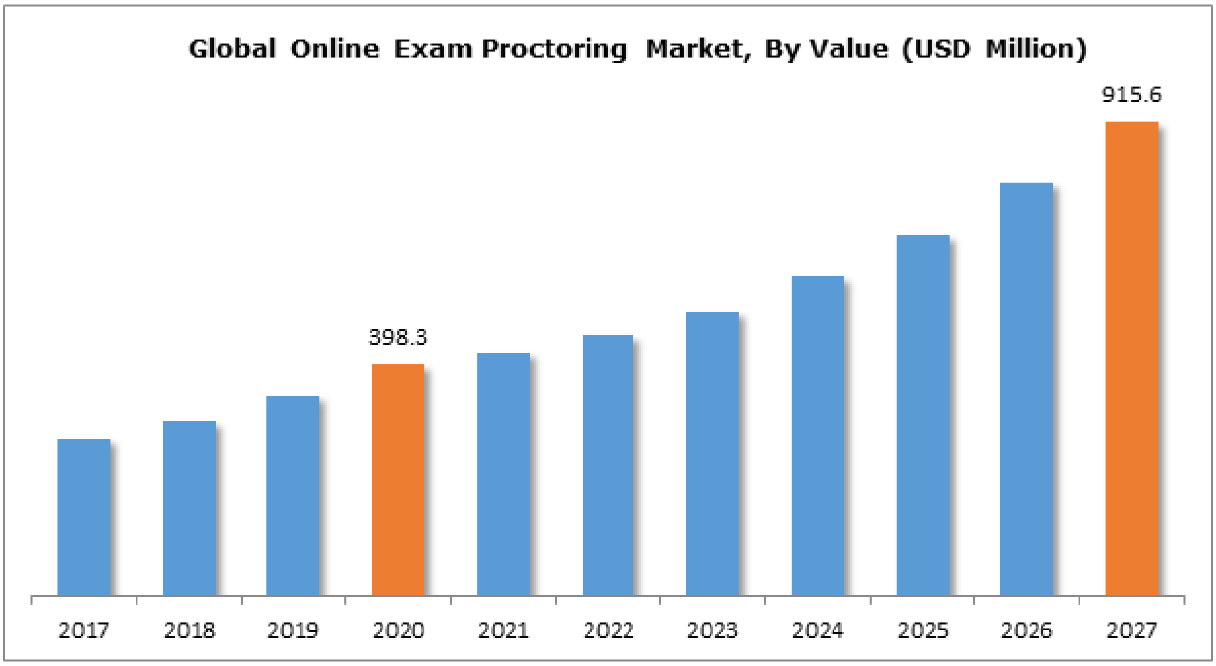



Figure 35. Global online exam proctoring market [BlueWeave Consulting, 2021].

## 2.13. Motivation and Drop Out in e-Learning

Motivation is a complex subject, and many theories have emerged to explain why people behave the way they do and forecast or estimate what others will do due to these theories. Even though motivation is widely recognised as an essential factor in learning, it is surprising that research on motivation in multimedia learning receives so little attention in the literature. Indeed, an evaluation by Elliott and Dweck shows that “among more than 5,000 citations, no reference is made to cognitive load theory and the stage model of information processing” [Elliott A. J., Dweck C. S., 2005]. Contrary to this, Lowe separated the motivational elements of animation from its instructive capacity [Lowe R. K., 2003]. It seems that two significant groups of researchers are underrating each other’s findings [Seel N. M., 2008].

As a result, we can locate only some theoretical strategies to integrate motivation into understandable systems of getting to know multimedia [Astleitner H., Wiesner C., 2004; Samaras H. *et al.*, 2006]. However, those models lack significant empirical proof, and upcoming studies need to examine the interconnections between the variables - motivation and cognitive. The infusion of motivation in studying multimedia is a complex challenge [Seel N. M., 2008].

External motivational factors, such as the design features of a multimedia package, are considered getting some initial motivation for learners to access the material but the **sustained effort is only achieved when they encounter internal motivational factors, such as engaging and meaningful content** [Najjar L. J., 1998]. This might also cause cognitive engagement, which is the technique in which newcomers are prompted to control completely their learning. Multimedia and computers enable “external regulation and autonomy support” [Stefanou C. R. et al., 2004].

Technology may offer tasks for context and range in studying theoretically what can be exploited to situate motivation. Hede sees the numerous motivational elements as affecting learner control or, specifically, learners’ effort and time to engage with multimedia. Beyond Hede’s version, there are three strategies to integrate motivation into multimedia studying: “1) schema-based approaches, 2) flow-based approaches, and 3) the uses-and-gratifications approach” [Hede A., 2002].

There are several factors for dropout rates. Some believe that dropping out is not a sign of failure and that new learner-centric models should enable students to drop out and drop in. Flexibility and accessibility are viewed as strengths rather than vices. According to learning psychology, Spaced Learning, rather than the fixed-time classroom experience, is more successful [Clark D., 2002]. According to some research, **online students are about twice as likely to drop out as on-campus students**. For example, Dutton and others explored two sections of the course “Introduction to Computer Programming”: one section was taught on-site and the other online. According to their findings, “there are substantial differences in the likelihood of students completing the course. The online students had a 72.2% completion rate, while 90.3% of the undergraduates completed their face-to-face course” [Dutton J., Dutton M., Perry J., 1999]. Research on enrolment and dropout rates for West Texas A&M University’s online MBA programme discovered that while online courses enrol more students than campus-based ones, they also have higher dropout rates. The study was carried out by analysing 15 graduate business courses offered in the past three years where the same professor taught both the campus-based and the online courses [Terry N., 2001]. According to Ally, ICT usage in education is far less significant than teaching strategies, testing, and assessment methods [Ally M., 2004]. Non-participation of students in learning plays a vital role in a high rate of dropout in online education [Dagger D., Wade V. P., 2004]. Consequently, it is essential to decide which methods might boost student engagement [Tyler-Smith K., 2006].

**A crucial aspect to drop a web-based course is communication or social contact between students and between the teacher and the students** [Astleitner, H., 2000]. After polling e-learners and e-learning managers from different organisations, the dropout rate for e-learning is estimated to be around 26% [O'Connor C. et al., 2004]. Carr stated that "almost every distance-education instructor and a student have a different explanation for why students drop out of online courses". All these explanations can be separated into two sections [Carr S., 2000]:

a) the assumption that students drop out from distance learning courses for basically the same cause they drop out from on-site education,

b) the notion that the motives for dropping out are related to the essential variations among the two modes of instruction.

Although there are many causes why learners drop out of courses, these reasons can be specific for students enrolled in an online course. "Issues of **isolation**, **disconnectedness** and **technological problems** may be factors that influence a student to leave a course" [Willging P. A., Johnson S. D., 2004].

Kavi presents in the form of an infographic the main reasons for high dropout rates in e-learning courses (Figure 36), while Yeşil analyses factors to increase the motivation of e-learning users (Figure 37).

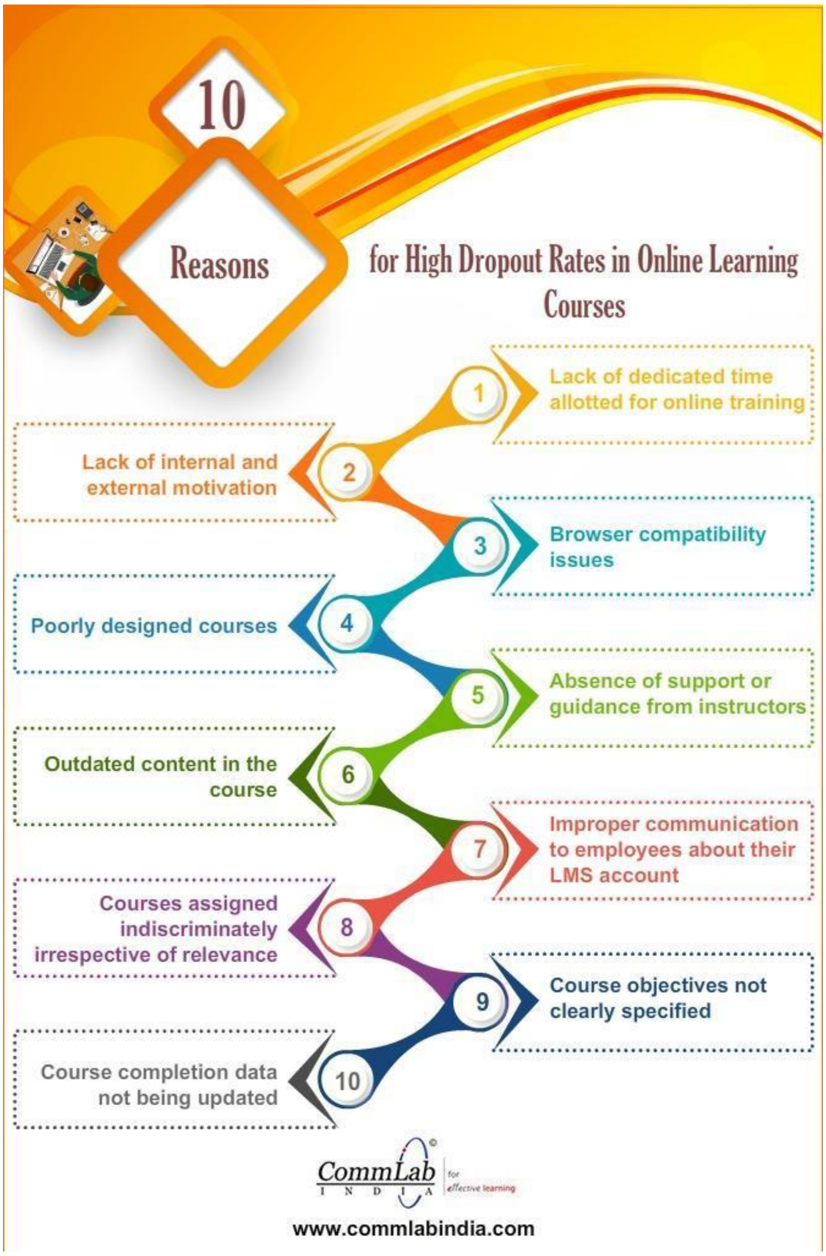



Figure 36. Reasons for high dropout rates in e-learning courses [Kavi J., 2015].

# 8 WAYS YOU CAN INCREASE LEARNER MOTIVATION IN E-LEARNING

Students' interest and motivation can easily be lost if the online learning environment is not well-designed. Consider these essential design tips if you want to create positive learning experiences.

by Didem Yesil

## 1 CONCRETE COURSE OBJECTIVES

Learners need to see what they will have gained by the end of this course not only at knowledge level but also performance level. Course objectives should be clearly indicated so that learners know how the course will impact their skills.

## 2 SENSE OF PROGRESS

Give learners the opportunity to realise they are making progress. Ask them questions, have them reflect on their learning or give them direct feedback. When learners feel they are making progress, they are more likely to find the course useful.

## 3 TASKS TIED TO LEARNER'S CONTEXT

Learning tasks should be related to learner's real-life contexts. For example, if it is a training course, ask them to apply the knowledge in their job context. Learning is more effective when the knowledge is applied in offline environments.

## 4 VARIED CONTENT

Vary the course material both in terms of type and level. Give them short video lectures, animations, external websites, articles, podcasts, blog posts etc. They build connections between different materials. Students at different levels also take what they need from this variety.

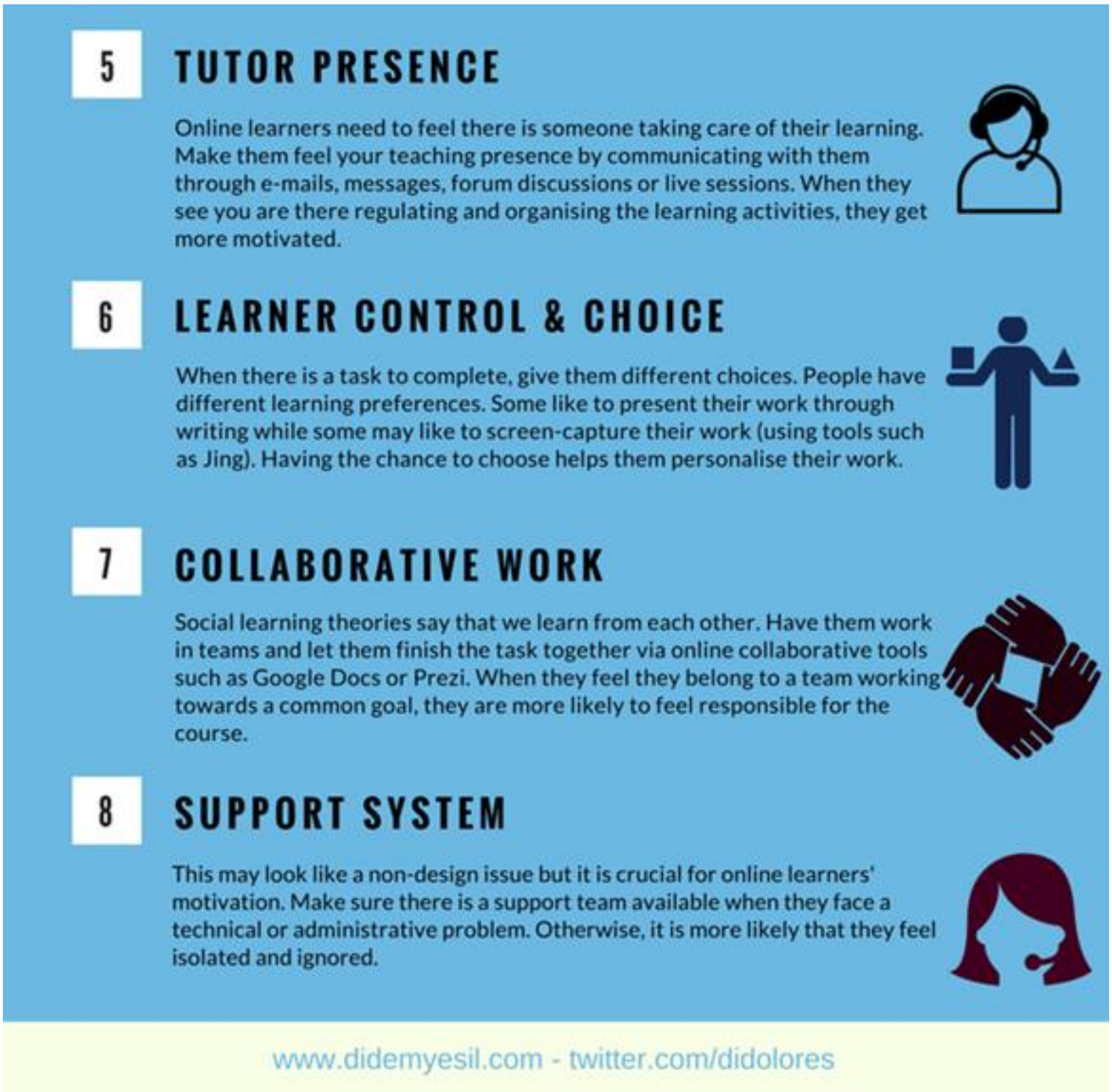



Figure 37. Ways to increase learner motivation in e-learning [Yeşil D., 2016].

As per Dubey and Piroska's recent literature review, **the distraction factor is the main element decreasing motivation towards e-learning among students** (Figure 38) [Dubey S., Piroska B., 2019].

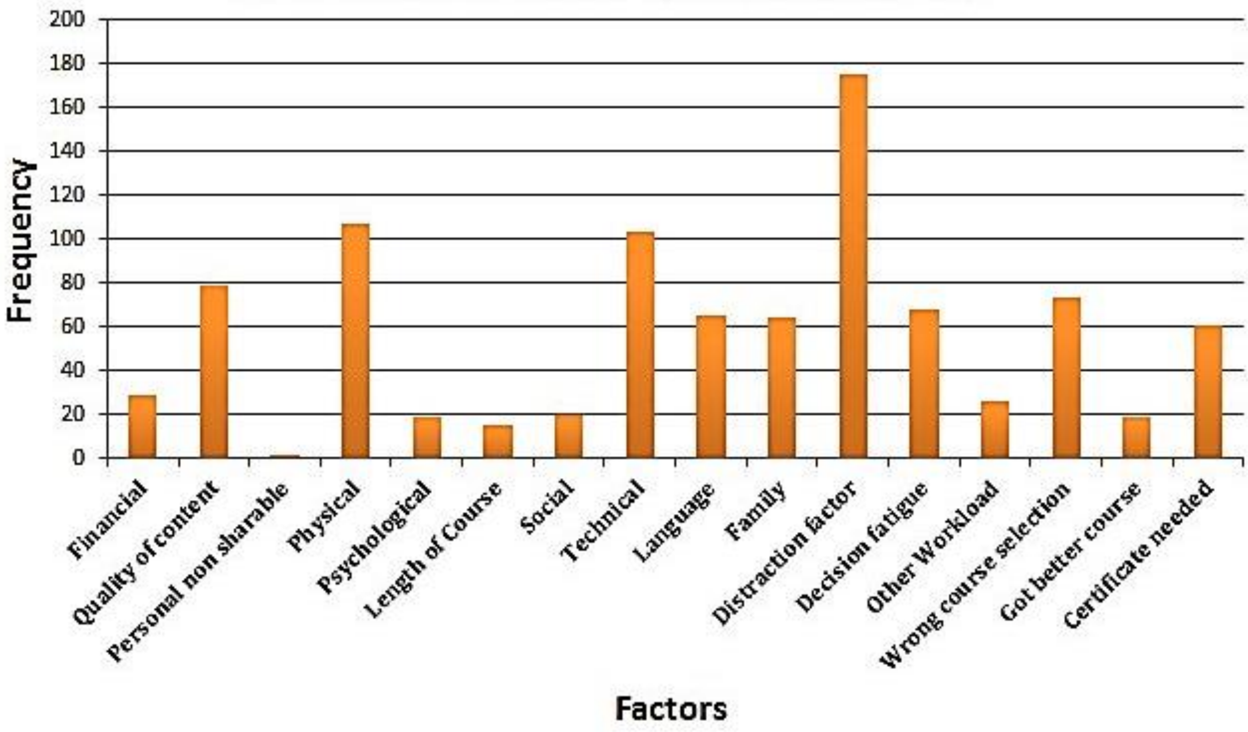



Figure 38. Factors affecting learners' motivation for e-learning [Dubey S., Piroska B., 2019].

## 2.14. Mental obstacles for e-learning

Just as building a bridge is based on sound engineering principles, it does not differ from learning based on sound psychological principles. **There is a considerable gap between theory (education) and practice (training)** [Clark D., 2002].

The lack of interest and the reluctance among individuals to take part in various sessions of e-learning are essential questions that apply to many students [Juutinen S., Saariluoma P., 2007]. It poses a challenge to expand this style of education. “Thinking about the future, the mental obstacles for participating in e-learning easily result in losing important opportunities in advancing one’s personal development” [Juutinen S., Saariluoma P., 2010].

The troubles of emotional barriers towards e-learning are a psychological concern. On the whole, emotions constitute a comparatively primitive scheme, as revealed by the significance of subcortical and evolutionally primordial parts of the brain for “emotional processing” [Rolls E. T., 1999]. Emotions not only play a crucial role in humans’ actions but are also indispensable in forming precedences [Oatley & Johnson-Laird, 1987; Parrott W. G., 2004].

In our relationship with the outside world, the role of emotions is significant as they explain why some courses of action are adopted and others rejected. It is fundamental to analyse these "action-controlling" functions, as they are also important in the human-technology relationship. "Emotions form a key area in user psychology" [Juutinen S., Saariluoma P., 2010]. Several studies propose that "emotions have an important role in e-learning". Studies have shown that e-learning systems can cause frustration, confusion and even reduce interest among users [Shneiderman B., 1976; Alavi M., Yoo Y., Vogel D. R., 1997; Hara N., Kling B., 2000; Drennan J., McColl-Kennedy J., 2003; Zhang D. *et al.*, 2004; Juutinen S., Saariluoma P., 2006; Juutinen S., Saariluoma P., 2007].

**e-Learning necessitates self-discipline** among students. Thus, the need to overcome emotional obstacles cannot be over-emphasised [Hiltz S. R., Wellman B., 1997; Kumar A., Kumar P., Basu S. C., 2001]. One study reported that in an electronic class where new methods of teaching were utilised, students were more actively involved in the teaching-learning process compared to a traditional way of education in which students may have little to no interest [Juutinen S., Saariluoma P., 2010].

It is crucial to analyse emotional obstacles in e-learning. Success or failure in using programmes and devices results in pride and frustration, respectively [Juutinen S., Saariluoma P., 2010]. Pride increases students' motivation to learn and makes it easy to become accustomed to new concepts. In contrast, frustration incites a lack of interest, reduced willingness to learn and eventually results in failure among students [Juutinen S., Saariluoma P., 2006]. **Studies have shown that students' lack of social interaction and feelings of seclusion harms their academic performance.** This is apparent in distance learning [Tsai I.-C., 2012].

A basis of human-technology interaction which is designed by the analysis of users in interaction is formed by user psychology [Saariluoma P., Sajaniemi J., 1994; Oulasvirta A., Saariluoma P., 2004; Saariluoma P., 2004, 2006; Leikas J., Saariluoma P., 2008]. It focuses on analysing the human mind in interaction and thus does not presume any specific technologies. Therefore, questions concerning emotional obstacles to e-learning should be asked [Juutinen S., Saariluoma P., 2010]. "Until recently, relatively little attention has been paid to the way emotions work in interaction" [Norman D., 2004]. Systematic research in emotional behaviour is essential to explore human motivations and actions and the role emotions play in them [Abele-Brehm A., Glendolla G., 2000; Franken R. E., 2002].

The reactions of people differ from one situation to another. These reactions are, to some extent, learnt and dependent on prior experiences of an individual. People may associate similar technology in an entirely diverse emotional context. Some associate positive emotions with new technology, while others view technology from a negative perspective. [Saariluoma P., 2004]. People's emotional reactions do not stay the same; they are altered steadily throughout their lives [Power M., Dalgleish T., 2008]. Thus, people's emotional context can change. For instance, someone who negatively perceives technology can like and value technology over time [Saariluoma P., 2004].

The methods of e-learning presently practised in education seem not to arouse students' interest, as those involved are likely to be isolated and short of communication. This can lead to varying signs of social isolation among students and teachers who cannot communicate online. In most cases, social isolation and a lack of communication result in some mental health problems, such as anxiety, increased stress, and negative thoughts. Several ways to fight loneliness and social isolation in e-learning include: 1) interaction and communication between participants should be promoted, 2) utilising hybrid learning environments, and 3) students should be monitored for signs of loneliness and social isolation [Tamm S., 2019].

With the development of technology, comes the need for people to build up their work habits. For some, this is the norm. When a new technology emerges, they incorporate it into their daily routine and their job as well. Whereas for others, this change and meeting up with the demand for new technology is an uphill task. They are unwilling to adopt any technology to complement their traditional actions, even when it may improve their performance. These kinds of individuals are said to be technophobic. Technophobia (fear of new technology) has been seen ubiquitously, considering the surge in technology we are surrounded by. Technophobia is more visible among individuals than ever before. Thus, the study of technophobia is gradually becoming more relevant when examining technology's influence on user psychology [Juutinen S., Huovinen T., Yalaho A., 2011].

Quarantines enforced as a result of COVID-19 have compelled the quick deployment of e-learning, but they have also raised rates of anxiety, depression, and fatigue, all of which correlate to reduced e-learning motivation. As a result, it was important to uncover e-learning motivational aspects associated with mental health [Dirzyte A. et al., 2021].

Student motivation and, in general, the result of the learning process appear to be influenced by affective and emotional elements. It might enhance student motivation and performance by identifying and regulating the emotions underlying a learning activity [Rodriguez P., Ortigosa A., Carro R. M., 2012]. These findings reinforce the relevance of social contact and communication mechanisms in online education and show that if these elements are not properly implemented in e-learning, the lack of social interaction and its negative impact on students' educational experience may worsen.

## 2.15. COVID-19 Impact on e-Learning

Many countries have implemented a reduction in gatherings to contain the virus. Some schools had to reduce classes or close entirely. "**As of July 2020, 98.6% of learners worldwide were affected by the pandemic, representing 1.725 billion children and youth, from pre-primary to higher education, in 200 countries"** [United Nations, 2020]. Loss of educational opportunities, potential loss of human capital and diminished economic opportunities are associated with school closures. Homeschooling is one of the alternative ways of providing access to education for children through technology, such as online courses, video classes and electronic textbooks. To minimise the impact of closures, schools have been looking for alternative ways to provide access to education. On the side of homeschooling, students and children are nowadays, wherever possible, educated remotely [European Data Portal, 2020].

According to data from Pi Datametrics, "the search terms related to online learning saw the biggest highest year-on-year growth on Google in the United Kingdom from January to April 2020 compared to the same period in 2019". The term "free online learning" was the most searched keyword (Figure 39) [Pi Datametrics, 2020].

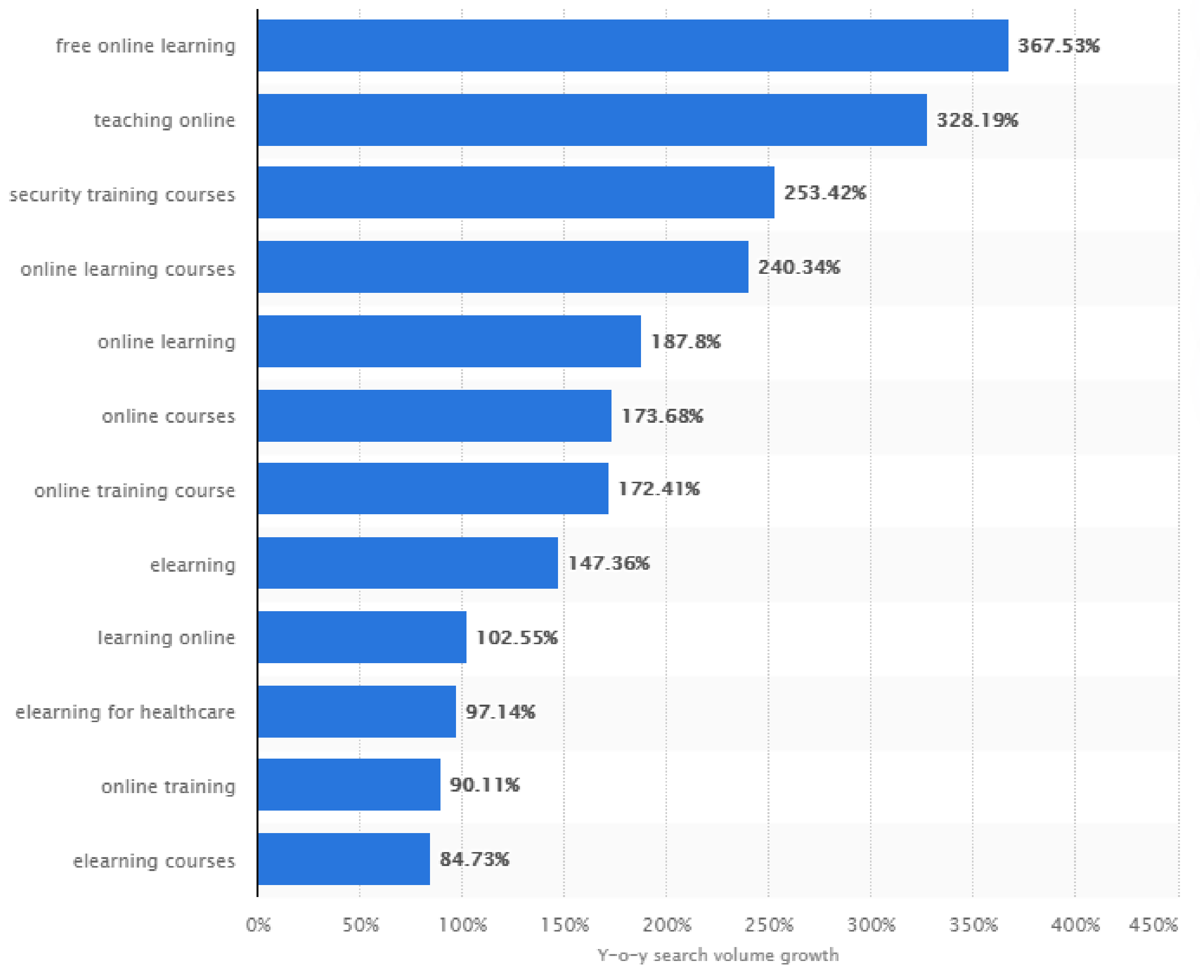



Figure 39. e-Learning keyword growth during COVID-19 in the UK [Pi Datametrics, 2020].

The World Bank supported using technology to provide remote learning opportunities for students whilst schools are closed. Learners, schools, teachers and families have engaged in online learning where learning is done remotely and on digital platforms. Sweden did not shut their primary schools, while some school facilities in Belgium and Norway were open for some categories of children. A catalogue listing of the measures taken per country is provided by the World Bank [European Data Portal, 2020]. The actions adopted have already impacted higher education. They have significantly influenced the conditions under which higher education was forced to do research and what is now often referred to as “emergency online education”. To envision medium- and long-term possibilities, it is critical to comprehend “what is going on right now, as well as the implications for national and foreign students, part-time, contract-based, or tenured teachers, and all other employees” [Marinoni G., van’t Land H., Jensen T., 2020].

The first International Association of Universities Global Survey on the impact of COVID-19 on higher education was conducted in Spring 2020. In Spring 2020, the International Association of Universities conducted the first global survey on the impact of the COVID-19 pandemic on higher education. It got 576 responses from 424 universities and other higher education institutions from 109 countries and two Chinese Special Administrative Regions (Hong Kong and Macao). COVID-19 has influenced almost all of the institutions that responded to the survey. Only one institution (in Burundi) responded that it remains open as usual, with no additional measures in place for COVID-19. At the same time, 59% said that all campus activities ceased, and they were closed (Figure 40) [Marinoni G., van't Land H., Jensen T., 2020].

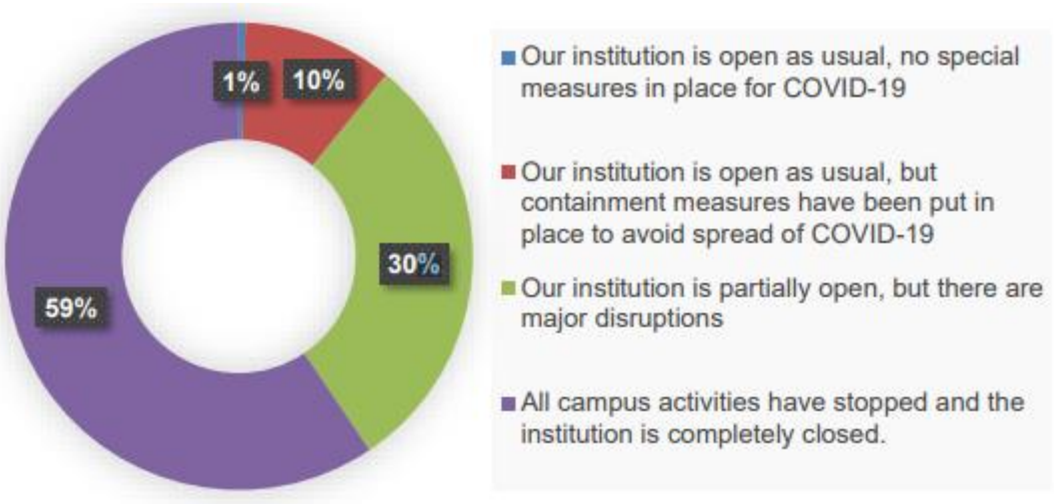



Figure 40. How has the COVID-19 pandemic affected your institution? [Marinoni G., van't Land H., Jensen T., 2020].

Another aspect is how well educational institutions are prepared for and involved in e-learning and how well teachers are prepared for and engaged in online teaching. On average, 65% of 15-year-olds from Organisation for Economic Co-operation and Development (OECD) nations are enrolled in schools. In a poll, the school principal said that instructors had the technical and pedagogical skills to integrate digital devices into remote education. Teachers are critical to the success of distance learning deployment. **UNESCO found that**

**over half of all education systems assessed, across all economic levels, are offering additional teacher training to prepare for remote education** [European Data Portal, 2020].

In the course of this pandemic, e-learning plays a crucial role. Online learning tools can assist learning providers in planning, managing, and tracking the learning and teaching process. In addition, it aims to help teachers, schools and universities facilitate student learning during the closure of these institutions. Also, most of these tools are for free, ensuring continuous learning during the pandemic [Almaiah M. A., Al-Khasawneh A., Althunibat A., 2020]. “However, the shift to online mode has raised many queries on the quality of education” [Sahu P., 2020].

According to Bates, the annual growth rate of fully online learning will remain around 10% by 2020, and due to Covid-19, the growth will accelerate in the next few years, and the slow growth will resume from 2025. It will continue to grow slowly beyond 2030, mainly because of lifelong learning and immigration. At the same time, due to demographic reasons, fewer students are graduating from high school, so the number of enrolments on campus may decrease. However, the most significant growth will occur in blended learning. As instructors have become more familiar with online learning because of the pandemic, they will integrate it more and more into their regular teaching (Figure 41) [Bates T., 2020].

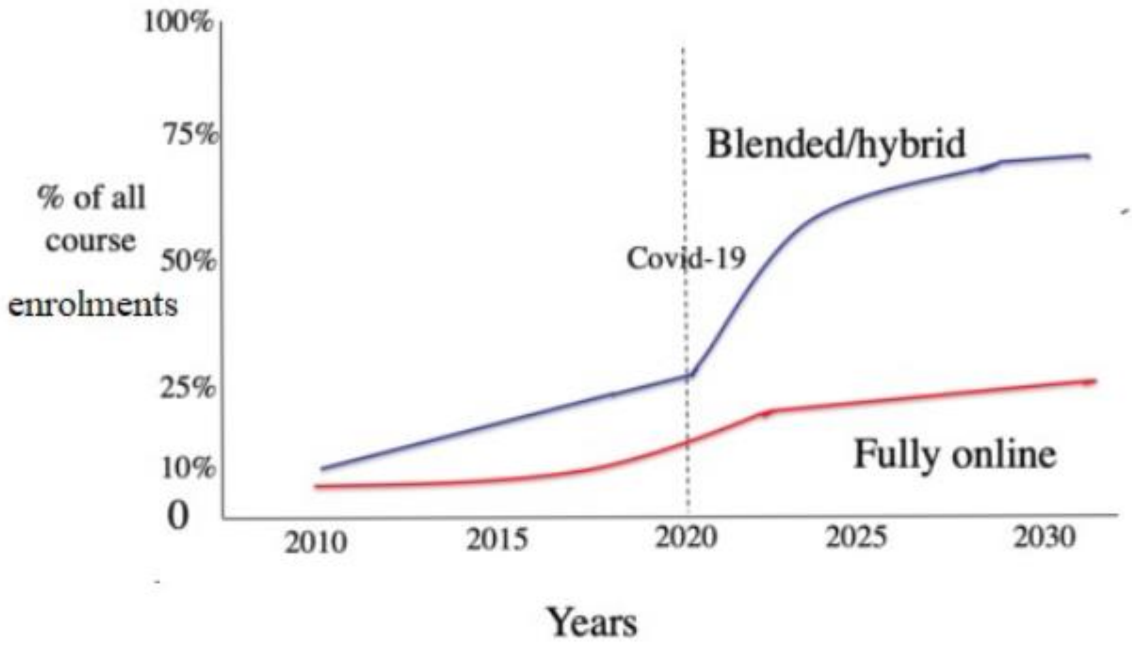



Figure 41. The potential impact of COVID-19 on e-learning enrolments [Bates T., 2020].

The education quality and outstanding infrastructure of information technologies are in demand. Thus, universities are altering their teaching models by employing intellectual capital [Alvino F. *et al*., 2020; Cai L., Zhu Y., 2020]. Students and teachers meet some difficulties with the unexpected transition from face-to-face to online learning during the pandemic. "(…) most countries have significant issues with technological infrastructure in rural areas (…)" [Shahzad A. et al., 2020]. According to a report issued by OECD, "in many European countries, over 95% of students report that they have a computer to use for working at home" (Figure 42). "However, in Indonesia, for example, only 34% have a computer (…)" [European Data Portal, 2020].

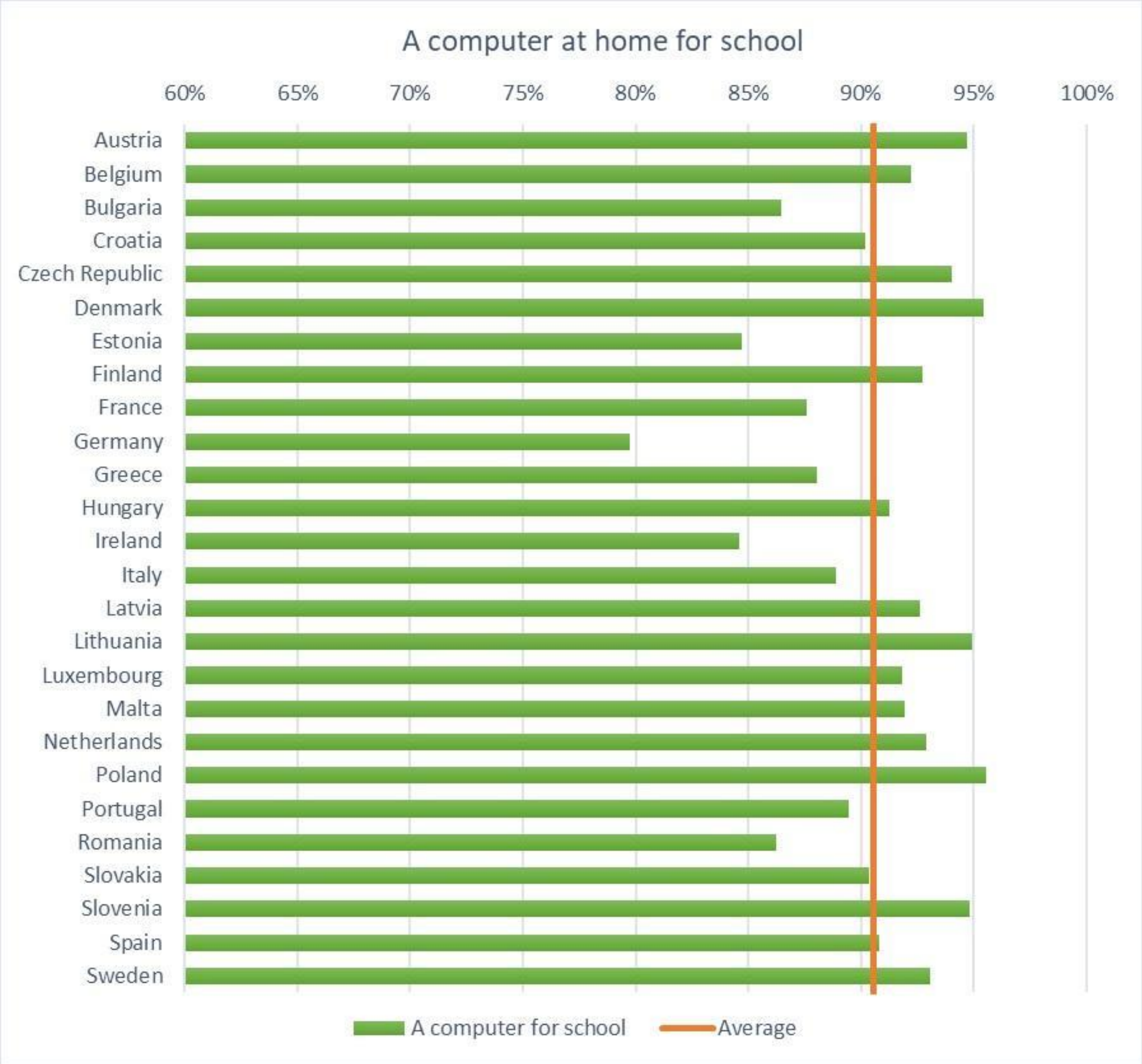



Figure 42. Percentage of 15-year-old students in the EU who reported having a computer at home for school [Reimers F. M., Schleicher A., 2020].

Even though students at the finest full-time virtual schools can perform on par with or better than traditional schools, most studies have concluded that full-time online learning does not produce the same academic results as in-class learning [Dorn E. *et al.*, 2020].

As seen by the growth of e-commerce following SARS, major worldwide crises are typically a tipping point for rapid innovation. While it is not known yet if this will apply to e-learning beyond COVID-19, it is one of the few areas where funding has not stopped. If online learning has a role to play here, it is expected from all of us to explore its potential [Li C., Lalani F., 2020].

## Chapter Summary

In the first chapter, the definition of e-learning, its history and framework are presented, various advantages and disadvantages of remote learning are confronted. There is introduced the role of Virtual Reality and Artificial Intelligence in e-learning with some examples. After that, I describe Massive Open Online Courses and their role in the training of public servants, providing examples from different countries. There is also a description of blended learning and experiential e-learning. I explore the issue of the high dropout rate in online courses and how it can be prevented. Further, I investigate cheating prevention in online assessments and present some procurement tools used by various institutions worldwide. The last part is dedicated to the impact of the COVID-19 pandemic on distance learning.

# 3. PUBLIC ADMINISTRATION CONTINUING EDUCATION

**Public service is "a service that is provided by the government to people living within its jurisdiction, either directly (through the public sector) or by financing the provision of services"** [McGregor E. B. Jr. *et al.*, 1982]. The term refers to a social agreement (typically expressed through democratic elections) that certain services should be offered to everyone. Even where public services are not supplied or funded by the government for social and political reasons, "they are generally subject to regulations that go beyond those that apply to most economic sectors" [Anderfuhren-Biget S. et al., 2014].

In developed countries, the term 'public services' (or 'services of general interest') involves "electricity, education, emergency services, environmental protection, fire service, gas, healthcare, law enforcement, postal service, public broadcasting, public library, public security, public transportation, public housing, social services, telecommunications, town planning, waste management, water supply network" [Fenwick J., McMillan J., 2014].

Teaching a public administration practitioner alongside, or in place of, an academic, social or political science audience raises significant issues. Differentiated teaching methods have become increasingly common, but the emphasis on what is taught has become more elusive. Public administration education is a diverse and contested field of academic endeavour [Fenwick J., McMillan J., 2014].

Governments invest a lot to create more efficient and effective public services. Considerable effort is put into the training of digital skills. However, the desired result is not yet achieved since a transformational approach for the primary users of the services, the public administration officials, is still missing [Papastylianou A. *et al.*, 2020]. We miss the capacity to train continuously civil servants to meet the ever-changing public sector conditions and needs in many developing and developed countries. The United Nations/International Association of Schools and Institutes of Administration (UN/IASIA) Standards of Excellence for Public Administration Education and Training, as well as implemented accreditation systems, will go a long way in responding to these critical challenges [Rosenbaum A., 2015].

## 3.1. Challenges of Continuing Education

In 1980, 4 assumptions were made by Knowles on the characteristics of adult learners, which differ from those of children's learning. In 1984, Knowles added the fifth assumption [Knowles M. S., 1984]:

1. **Self-concept**: their concept of being dependent moves towards a self-directed person.
2. **Adult Learner Experience**: they accumulate more and more experience, which gradually becomes a learning resource.
3. **Readiness to Learn**: their learning is oriented to their social roles.
4. **Orientation to Learning**: their time perspective changes from the postponed application of knowledge to the immediacy of application. Accordingly, their direction towards learning shifts from subject-oriented to problem-oriented.
5. **Motivation to Learn**: as a person matures, the motivation to learn becomes internal.

Based on the above characteristics, Knowles also suggested four principles that apply to adult learning (Figure 43) [Kearsley G., 2003]:

1. Adults should participate in the preparation and evaluation of their learning.

2. Experience (including mistakes) provides the foundation for learning.

3. Adults are more interested in learning subjects directly related to their work or personal life.

4. Adult learning is problem-centred rather than content-oriented.

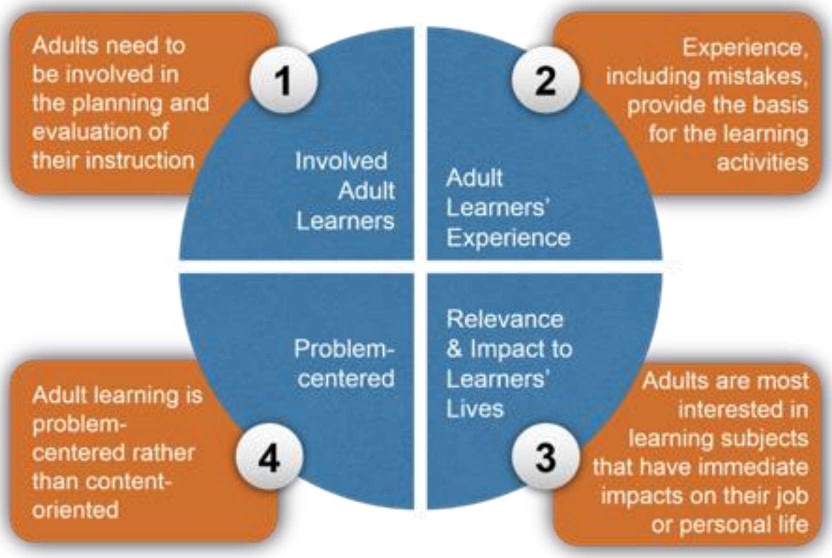



Figure 43. Four principles of adult learning [Mancuso A. A., 2018].

Continuing education is about adults. Therefore, e-learning post-graduate courses must adhere to adult learning principles and adjust to curriculum and techniques that best meet the needs of learners [Aggarwal R. *et al.*, 2011; Legreid Dopp A. *et al*., 2010].

Many adults like to learn through interaction and in social situations, and they are driven by the prospect of making new friends [Lieb S., 1991]. According to one Australian study, online education cannot fully address all the skills and attitudes necessary for young health professionals. Due to the lack of face-to-face interaction, **online learners may feel isolated from their peers** [Karaksha A. *et al*., 2013].

The process of adult learning is described by Knowles as **self-directed inquiry** [Knowles M. S., 1973]. In a study on the implications of adult learning, Taylor and Hamdy list the following needs: “1) relevance and goal of what they are learning, 2) autonomy and self-directedness, 3) connection with past experiences, 4) readiness to learn, 5) orientation to learning practical aspects, 6) motivation, 7) respect: be treated as equals by their instructors” [Lieb S., 1991; Taylor D. C., Hamdy H., 2013].

### 3.2. The United Nations/International Association of Schools and Institutes of Administration (UN/IASIA) Task Force on Standards of Excellence

The Division of Public Administration and Development Management of the United Nations Department of Economic and Social Affairs (UN/DPADM) responded to the rising awareness of the importance of public affairs education and training. The institution started discussions with the International Association of Schools and Institutes of Administration (IASIA). It was agreed to establish a Task Force on Standards of Excellence for Public Administration Education and Training. In 2009, the task force published a report presenting eight Standards of Excellence [Rosenbaum A., 2015].

**Standards of Excellence** [Rosenbaum A., 2015]:

1. **Public Service Commitment**: The faculty and administration of the programme are described by their commitment to public affairs. They are dedicated to protecting the public interest and the construction of democratic institutions.

2. **Advocacy of Public Interest Values:** The faculty and administration demonstrate their dedication to public affairs development by advocating for and working to build a culture of involvement, commitment, responsiveness, and responsibility in all organisations and institutions with which they interact.

3. **Combining Scholarship, Practice and Community Service:** The faculty and administration are dedicated to the convergence of theory and practice. As a result, the programme draws on knowledge and understanding created by high-quality research and practical experience. The faculty, administration and students are involved with their stakeholder groups via teaching, training, research, and service activities.

4. **The Faculty is Central:** The commitment and quality of the professors (and/or trainers) are essential to fulfilling programme goals.

5. **Inclusiveness is at the Heart of the Programme:** An unwavering commitment on the side of professors and administration to various views and involvement is a crucial component in achieving success in public administration education and training. Participants in courses should represent the society’s racial, ethnic, and demographic populations. The programme’s

ideas, concepts, theories, and practices should reflect a wide range of intellectual interests and perspectives.

6. **A Purposeful and Responsive Curriculum:** The creation of public administrators who will make significant, constructive contributions to the public service and, in particular, to the organisations they join or return to is a significant aim of public administration education and training. This necessitates the creation of clear missions. It is also important that people who educate and train public administrators connect with and engage with the institutions for which they are educating students and trainees.

7. **Adequate Resources are Critical:** The availability of appropriate resources is a necessary condition for developing a programme of excellence in public administration education and training. Facilities, technology, library resources, and student services are just a few of the needed ones. The provision of these resources depends on enough financial resources. These funds must support full-time teachers and/or trainers, offer essential help to students and faculty, and guarantee the provision of enough classroom, research, training, and meeting space.

8. **Balancing Collaboration and Competition:** Finally, and most significantly, there must be a feeling of common purpose and mission among programme instructors, trainers, administrators, and learners that stems from the programme's dedication to advancing the public interest.

## 3.3. A Framework for Analysing Public Service Education

A simple logic model for public service educational programmes is illustrated in Figure 44. Reading left to right, the logical progression flows from the support and resources used to provide public service education to specific activities, which are expected to result in the outputs of changed behaviour of both public service faculty and students, which are expected to occur in outcomes such as improved governmental operations and civic engagement. The way educational programmes operate, from the nature of their resources to their ability to enhance governmental and societal conditions, is expected to be shaped by the context they have developed [Rosenbaum, 2015].

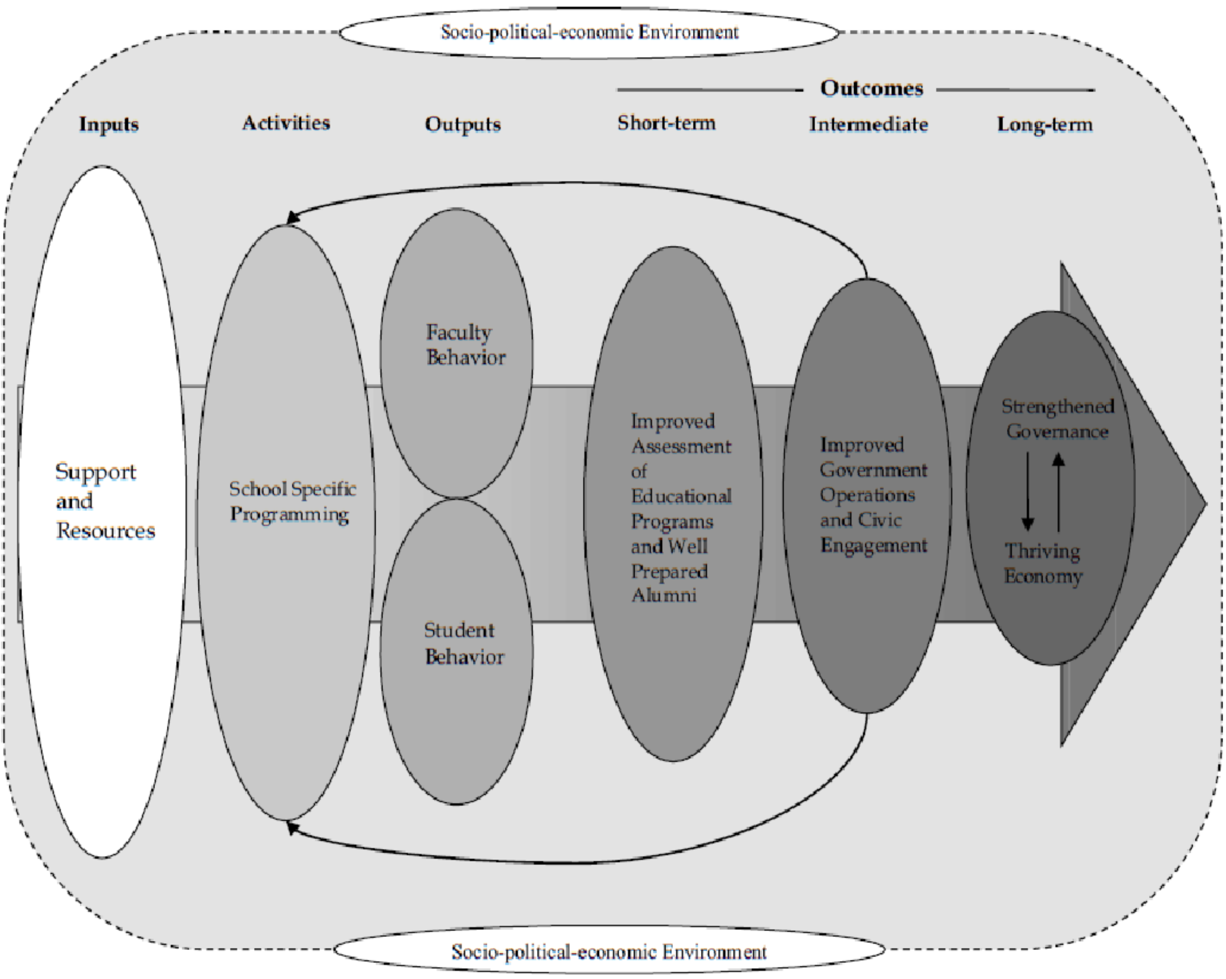



Figure 44. Simplified framework for public service education [Rosenbaum A., 2015].

## 3.4. The Role of Information and Communication Technologies (ICT) in Public Service

The National Institute of Standards and Technology defined information technology (IT) in a public administration environment as “any equipment or interconnected system or subsystem of equipment that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency. The term information technology includes computers, ancillary equipment, software, firmware and similar procedures, services (including support services), and related resources”. An information system is “a discrete set of information resources organised for the collection, processing, maintenance, use, sharing, dissemination, or disposition of information” [Kissel R., 2013].

The public sector is increasingly reliant on practical information and communication technology (ICT) management, and failure can have serious repercussions. Leaders must understand how ICT may assist their institution in accomplishing its goals and objectives. It is also essential to make sure that ICT usage is related to goals. The National Audit Office’s assessment of IT-enabled projects in 2004 discovered that initiatives tended to skip over the “business case” instead of diving straight into a detailed specification of what technology was required, with no clarity about objectives or success criteria [National Audit Office, 2004]. All too often, enthusiasts get carried away with the thrill of ICT’s potential – the gadgets, the amazing “extras” that never get utilised – and forget that all that is needed is a simple database. On the other hand, sceptics may simply want to use ICT to digitise current processes rather than reorganise work based on ICT’s potential to connect information and people in novel ways. If the aim of ICT is not understood, the system’s design and execution will be inadequate. People will perceive technology as a burden rather than a benefit [Jones A., Williams L., 2005].

## 3.5. e-Learning as an Opportunity for the Public Service

When Weber argued that “bureaucratic administration means overall domination through knowledge”, he must have had the necessity of public servant training in mind. This aspect of knowledge makes it particularly logical. It encompasses both scientific knowledge and information gained via an employee's work experience [Makridimitris A., 2004].

In public administration, e-learning has been successfully tested worldwide: conferences and journals report many unique experiences of successful e-learning usage in public bodies [Beamish N. *et al*., 2002; IDEA, 2002; Strother J. B., 2002]. e-Learning applications are used today by many private and public organisations and institutions that require continuous training as an instrument of excellence for their staff [Hrastinski S., 2008]. In that regard, modern public administration agencies utilise e-learning to provide their employees with customised programmes. Using such tools allows new means of interaction between trainers and trainees and surpasses all kinds of "time and space limitations that may hinder the conventional educational flow" [Aspridis G. *et al*., 2013]. e-Learning users emphasise the advantage of **time and place flexibility** in many studies while participating in e-courses [Romero M., Barberà E., 2011]. However, some issues need to be addressed. First and foremost, these technologies must be widely used, not merely isolated experiments committed to solving logistical difficulties when large numbers of people must be educated. Second, distant learning activities must be integrated into the organisation, rather than a one-off trial with new technology. In this regard, the concept of lifelong learning might be an intriguing viewpoint, particularly in a company where turnover is often low [Casagranda M. *et al*., 2010].

**The autonomy of the learning rhythm, the interactive environment, the low cost, the easy access to learning, the reduction of training time, the increase in the number of trainees**, and finally **the ease of updating and upgrading** are all advantages for an organisation that incorporates e-learning methods [Nikitopoulos D., 2003; Preston R., 2011]. Organisations should consider using e-learning solutions for the reasons listed in the infographic below (Figure 45) [Uppu N., 2017].


Figure 45. Main reasons why organisations consider e-learning solutions [Uppu N., 2017].

According to Šperka, the development of an e-learning portal in public administration could bring with it various benefits [Šperka R., 2016]:

- Save by sharing and optimising the source.
- Plan and evidence: supporting the curriculum regardless of the form of realisation.
- Practical distance learning support.
- Full use of various standards: the availability of educational content from various national and international suppliers.
- Make the most of the source, i.e. broadband, existing information and teaching content, workstations, methods, and teachers.
- Support for local activities, decentralisation and distributive approach, with centralised control also possible.
- Multi-domain access at one place: Having a platform to share information, knowledge, and inter-agency collaboration can lead to this stage of unification.
- Community support.
- A unified approach to administrative competence and competency profiles.
- Self-study support.
- Possibility of finding people with specific skills for a particular task.
- Effective and transparent training plans according to future needs and sources (such as changes in the mission project legislature).
- A unified approach to the dissemination of information as well as lectures and courses.

Governments should use e-learning to school their officials to overcome cultural and organisational challenges [Braim S., 2004]. The term e-governance is strongly associated with public administration learning. Torres, Pina and Acerete define governance as "the rules, processes and behaviours that affect the way public administration functions, i.e. the organisation and culture of public administration. It is believed that governance itself is much more than the physical authoritative institutions, organisations and processes within the public sector. The effectiveness of systems of governance is particularly important because, if a failure occurs, then the government will ultimately be held accountable" [Torres L., Pina V., Acerete B., 2005].

For the sustainable growth of e-government, e-governance should be at the centre of national information and ICT policies [Torres L., Pina V., Acerete B., 2005]. Employees capable of managing changes in daily practice in offices, especially in the citizen-to-state relationship, are required for this role. Public servants should be taught to respond to citizen demands, and residents should be informed about available services. Here, a decent educational platform is required. Therefore, recommendations for e-learning are put forward to support public administration services and information dissemination [Šperka R., 2016].

## 3.6. The Need for Innovation in Training for Public Servants and Executives in Hungary

The scepticism that many people see in the public sector and those who work in the field is probably high, but not new. Over the last few decades, we have challenged public affairs in several ways. The work of those in charge of the public sector has been made more difficult by a nearly four-decade-long pattern of deliberately reducing the government's capacity to handle effectively public problems by reducing and disbursing state power in the name of public sector reform. The ability of public administrators to address major issues was likely further compromised, whether or not intentionally, by the emergence of the notion of "shared or collaborative governance", which was strongly advocated in the mid-1980s and early 1990s by various international organisations and many national governments [Rosenbaum A., 2015].

Generational transition, which is a global phenomenon, is linked to the labour force reserve. There are common action plan directions for tackling common challenges that should be considered in Hungary as well, including a new approach to education and continued training based on the principle of lifelong learning, as well as the increasing role of knowledge management, knowledge transfer and mentoring [Bokodi M. *et al.*, 2014].

In today's society, public administration is shifting from being seen as controllers to proactive service providers. It is expected to ameliorate continuously service quality while dealing with a rapidly changing context (law and regulation changes, societal globalisation, rapid technological evolution) and shrinking budgets. Modern advances in information and communication technologies, particularly the widespread use of social media, provide new ways of delivering services to people and sometimes need a significant reorganisation of PA offices. Proper implementation of such technology may significantly boost the PA's reputation among people while also improving the working environment for government workers. Nonetheless, these developments pose a challenge to public servants today, and prospective reorganisations of a PA office need them to learn and implement innovative processes and standards while working under tight deadlines [De Angelis G. *et al*., 2016].

State personnel are subjected to tremendous demands in today's public administration. It necessitates ongoing education, which requires acquiring new knowledge (facts, law acts, norms, rules, etc.), habits, and processes. This imposes the same standards on the educational sector, particularly universities. Employees' lifelong learning is now heavily encouraged by the European Union, which is aided by financial assistance flowing into this field [EEA blog SK/CZ, 2011].

One responsibility of a government is to provide individuals and organisations with accurate information and explanations (e.g. in the legislature area). Many sorts of electronic forms of education, communication, and information distribution are supported by the European Union. Modern organisations view education as a never-ending process tailored to the organisation's requirements, goals, objectives and many orientations. Therefore, these systems are becoming increasingly important, particularly as they integrate with knowledge management, enterprise resource planning and organisational management [Šperka R., 2016].

The Hungarian Government accepted a comprehensive public reform strategy to improve public sector performance and, as part of it, emphasised the need for an efficient human resource management approach. The HR strategy's comprehensiveness aims to develop long-term and sustainable solutions not just to keep talent in government but also to solve problems of public governance that go beyond traditional service quality and performance issues [Kis N., Nemeslaki A., 2014]. "**Knowledge sharing, capability and skill development not only might lead to more efficient organisational performance but also could contribute to better employability of public officials.** The application of ICT provides great opportunities to support these activities, enable a smoother knowledge transfer and training mechanism for public servants across different fields" [Matei A., Matei L., 2014].

"Public sector performance is essential for maintaining and increasing national competitiveness. In Hungary's case, an in-depth analysis of several competitiveness rankings, such as the IMD Competitiveness Yearbooks and the Global Competitiveness Indices, concluded that in the period 2000-2008 the overall competitiveness ranking dropped 10 places. At the same time, public sector performance had overshot this by an alarming 20 – twice as much as the general – downhill sliding. Without going into too much detail about all the components of the measurement, the main critical factors were pointed out such as general trust in the public governance structures and processes, the global problem of effectiveness-efficiency issues, and problematic or lacking knowledge transfer within and from outside of the public sector. It has, therefore, a deliberate strategy of the government to quickly address these problems by orchestrating a comprehensive and overarching public administration reform formulated in the Magyary Plan (MP) [1]" [Nemeslaki A. *et al.*, 2014a].

"The National University of Public Service (NUPS) has become the hub of Hungary's public service development" [Kis N., Nemeslaki A., 2014]. NUPS participates in Hungary's reform of public service and human resources training. The Institute of Executive Training and Continuing Education (IETCE), part of the NUPS, handled it. IETCE has several functions: (1) it manages the system of public administration basic and professional exams; (2) it improves the public administrative executive, leadership, and cross-training system; (3) it supports the previous tasks by arranging them and providing internal and external communication schemes [Nemeslaki A. *et al*., 2014a].

The project "Development of Electronic Training and Distance Learning Materials", launched by IETCE, aims to provide conceptual solutions for educational innovation, deliver relevant and helpful knowledge in public services, and create a system that ensures the continuous updating of the training content and offers appropriate training methods – basically by implementing an e-learning environment for public servants. Table 8 summarises the programme budget, scope, and timeline [Nemeslaki A., 2016].

Table 8. Summary of the e-Learning Development Program [Nemeslaki A., 2016].

| **Development of Electronic Training and Distance Learning Materials**<br>**State Reform Operational Program - ÁROP-2.2.19-2013-2013-0001** | |
|---|---|
| **Main project information** | |
| Responsible institution | National University of Public Service (NUPS) |
| Responsible unit | eLearning Methodological Centre (EMC) |
| Project duration | 13 months (1/7/2013-31/7/2014) |

[1] Zoltán Magyary (1888 – 1945) was the most eminent theorist of administrative sciences and reformer of public administration in Hungary.

| | |
|---|---|
| Amount of subsidy | 1.8 million euros |
| Co-financed by | European Social Fund |
| Delivery indicator | 35 e-learning courses – (extended to 100 within the duration, and 108 after 2015). |
| Impact indicator | 10,000 participants/visitors of the courses within the duration. |

Programmes such as the State Reform ÁROP-2.2.19-2013-2013-0001 "Development of Electronic Training and Distance Learning Materials" were designed to support these tasks' implementation.

"The key cornerstone of the project plan has been the special mandate of NUPS, entitling it to the sole provider of public service training and development. According to this mission, NUPS was expected to offer approximately 220 of these programmes in 2014. In late 2013, there were 55 nationally qualified professional competence development and training programmes and around 500 programmes held by public bodies which have been waiting for accreditation by NUPS. Although these figures are approximations, they are good indicators of the massive changes that have taken place in recent times, and they illustrate the wide choice of programmes in the field of public administration education" [Nemeslaki A. *et al.*, 2014a].

The project "Development of Electronic Training and Distance Learning Materials" concentrates on one aspect of developing a solid background for managing this growth of training programmes. It aims to bring conceptual solutions to provide relevant and helpful knowledge in public services, guarantee the continuous updating of the training content according to employers' expectations, and offer appropriate training methods. Over 200 different curriculum contents were developed during the project lifecycle, allowing developers to test methods that are not only new in Hungary but might serve as a basis for future training worldwide [Nemeslaki A. *et al.*, 2014a].

In parallel, a professional management structure was also created for the programme. The eLearning Methodological Centre established in IETC served as the long-term quality management and engine of innovation for e-learning development [Nemeslaki A. *et al.*, 2014a].

“The project objectives were in alignment with the state reform in Hungary started in 2010, according to which **more than 80,000 public servants need to go through mandatory training per year**. From 2014, public servants need to accomplish a predefined number of credits through institutional accredited courses annually. This demand is planned to be fulfilled by the National University of Public Service or the accredited training providers of courses, offering three-four programs for each public servant. From the efficiency point of view, the initiative of the programme was to provide an infrastructure which can really serve this education demand for the scheduled large target group. From an effectiveness point of view, the portfolio maintenance, personalisation, content quality and methodological appropriateness had also been important expectations from the programme” [Nemeslaki A. *et al*., 2014a].

## Chapter Summary

The second chapter includes the characteristics of public administration continuing education and its challenges. “Standards of Excellence” are presented in public administration education, elaborated by the United Nations/International Association of Schools and Institutes of Administration. I explore the role of technology-enhanced education in public service, particularly innovative training methods for public servants in Hungary, and the role of the National University of Public Service as the hub of Hungary’s public service development. I present the programme State Reform ÁROP-2.2.19-2013-2013-0001 “Development of Electronic Training and Distance Learning Materials” designed to support the implementation of e-learning courses for public servants.

# 4. PROPER DESIGN OF E-LEARNING COURSES

There is a lot of interest in the literature on the information quality offered by information systems. However, because online quality is a complex concept with multidimensional measurement [Aladwani A. M., Palvia P. C., 2002], the most important issue in evaluating the quality of any information system is defining the criteria by which the quality is determined [Buyukozkan G., Ruan D., Feyzioglu O., 2007]. The requirements are based on the system's aims and context [Alkhattabi M., Neagu D., Cullen A., 2010].

Current research on e-learning systems focuses extensively on the exploration, find and retrieval paradigm while ignoring specific aspects of e-learning design [Santos O. C., Boticario J. G., Marín D. P., 2013]. Even though e-learning systems are not necessarily created with metacognitive processes in mind, cognition and metacognition are integral parts of the learning process. They are highly linked to increased recognition in e-learning settings [Shih M., Feng J., Tsai C. C., 2008].

Another design consideration is consistency, which makes a system's elements recognisable and differentiated within the depiction [Bellur U., Vallieswaran V., 2006].

In the below described observational study, I focused on the proper design of e-learning courses. The research question was posed: **What are the success factors in designing e-learning courses with a multidisciplinary approach?**

In today's society, design and development teams play an essential role. They are in charge of a type of creative problem-solving. On the one hand, there is difficulty in leading such teams; on the other hand, such teams demand a certain level of expertise [Blasi L. *et al.*, 2008]. Unfortunately, such groups often struggle to solve complex problems, and without the necessary team training, they may not be able to reach their potential. Besides, studies show that when we try to comprehend complex issues, we often oversimplify the situation to understand as much as possible. Indeed, since misinterpreting factors within the system or mismanaging these factors can have devastating consequences, understanding complex structures is a significant challenge. Analysis of complex systems has identified several factors that make them difficult to understand, including continuous change and the high interdependence of multiple variables [Spiro R. J. *et al.*, 1992; Feltovich P. J., Spiro R. J., Coulson R. L., 1997]. The thing is that these complexities are often overlooked because people tend to build simplified understandings and explanations, leading to misunderstandings and potential mistakes. This phenomenon is called reductive bias [Feltovich P. J. *et al*., 2004].

**E-Learning Methodological Centre (EMC) created e-learning materials, using experts from different fields brought together to develop high-quality e-learning materials and measure their success factors.** The role of EMC was to achieve the goals of the ÁROP project, concretely to develop 35 e-learning training materials with the enrolment of 10,000 participants in these courses. Figure 46 illustrates the homepage of the e-learning platform where e-courses for public servants were provided [probono.uni-nke.hu/nyitolap, 2016].

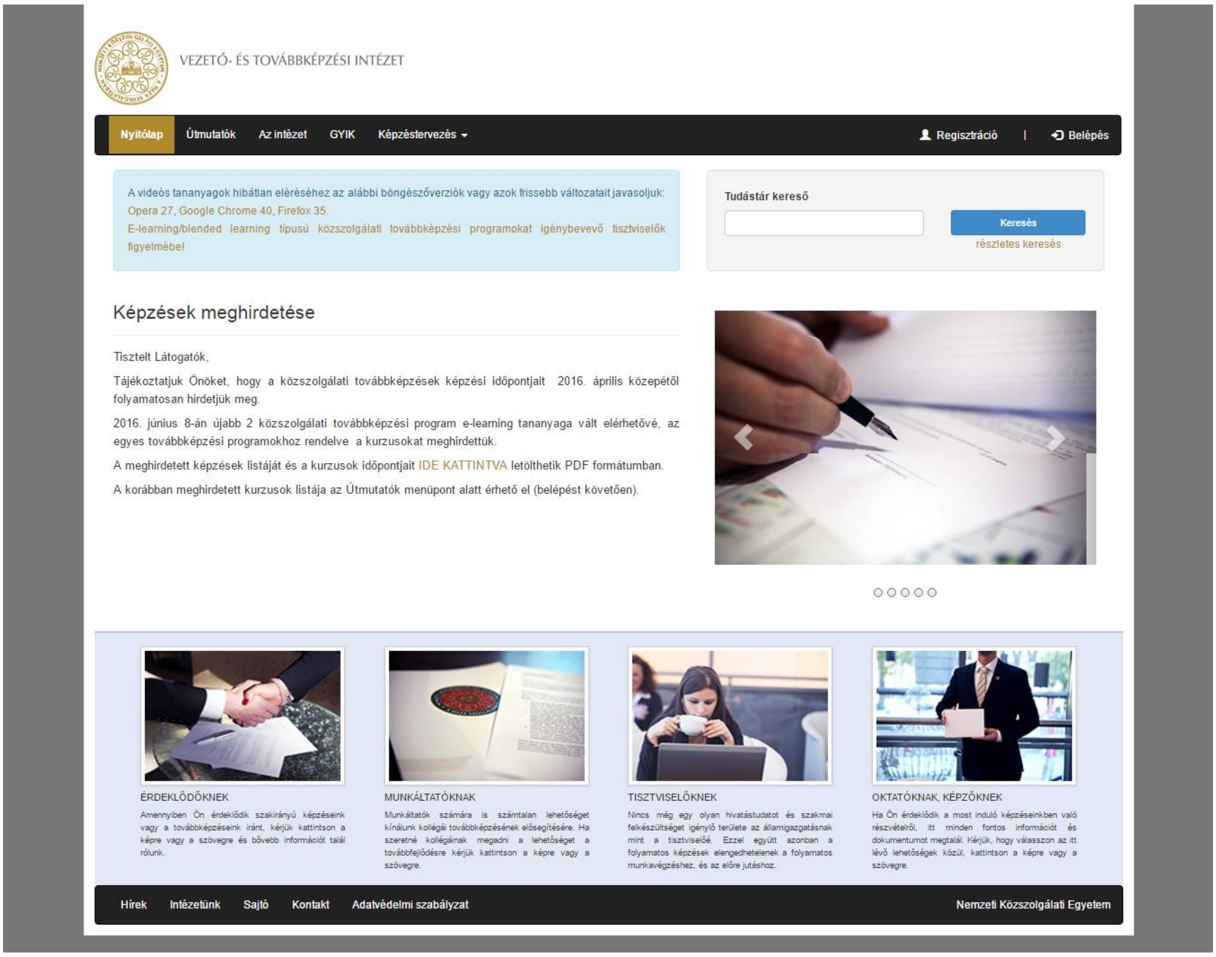



Figure 46. The homepage of the e-learning platform with e-courses for public servants [probono.uni-nke.hu/nyitolap, 2016].

This section describes how different professional groups worked together in EMC, ensuring that the objectives were met. These professional groups were the **project leader(s), methodological and technological experts, and curriculum writers (instructors).**

The critical tasks of **project leaders** were to identify and acknowledge processes, motivate people and maintain a productive team working environment. The project leader was Krisztián Kádár and the manager of the research unit, András Nemeslaki.

*"Our responsibility is huge because this project is one of the largest e-learning projects in Hungary, and it possibly determines users' attitude about e-learning for the future".*

Krisztián Kádár (project leader)

*"According to our intention, the project will outline the future of e-learning-based education platforms and how different professionals construct an effective social learning environment and content development process".*

András Nemeslaki (research leader)

The second group consisted of **methodological experts** responsible for selecting proper methodologies and their integration into the e-learning courses. They adhered to the notion that the purpose of e-learning is to extend the knowledge and skills of students by using different methods and modern technologies to understand the curriculum. The concept of blended and on-site learning had been considered all along the project lifecycle: where blended learning was defined as the mixture of on-site and e-learning. Blended learning courses were designed so that at the beginning and end of the classes, public servants were to use e-learning, so they prepared online and wrote their final exams online. In the middle of the course, however, they had to take part personally.

*"I became a teacher because I wanted to stand on the other side. I wanted to be with people since I am really interested in human beings. So, that was my reason to participate in this project. This is an IT project but my opinion is that this is a project which has a very*

*important IT side but humans are really important and also the way how we teach and how we learn".*

Ferenc Szani (methodological expert)

The third group comprised **technological experts** who wrote specifications and designed templates to get the correct input from curriculum writers. Documents from curriculum writers were checked according to quantitative and qualitative aspects. The obligatory inputs from writers were texts, scripts in excel formats and presentation slides. Excel scripts contained all the general information of e-learning materials, datasheets, glossary, questions, slides and their proper sequence. The developmental process of e-learning materials consisted of curriculum testing, validation, monitoring, and updating. The final destination was the ILIAS open-source learning management system.

Technological experts were the ones who brought the writers' and methodology experts' expectations to reality. This manufacturing process finally was automated in many steps, mainly due to the excessive demand for the initially 35 materials (eventually growing up to over 100 different courses), which was not feasible to handle manually. Technology experts developed original scripts which generated the final e-learning code automatically or semi-automatically. It started with a prezi.com presentation and often with green box technologies. Each video shot was equipped with subtitles to ensure that students could learn without headsets if they wanted to. This also provided opportunities to read the textbooks online, study glossaries and other text materials. Materials were designed with such intention that every component was downloadable. Texts could be saved in various file formats. The subtitles and the structure of the prezi.com presentation could be seen as an animated "mind map" diagram to visualise the structure of each course. Test questions and videos followed slides, asking for input from the user to make sure that students' attention was captured.

Technological experts also created their video player and search engine to measure customer satisfaction and create a feedback form; thus, students can rate the e-learning materials.

*“We are the so-called IT guys. We develop a specialised e-learning system and e-learning materials. In other words, our job is to make the big dreams of methodological experts come true”.*

Zsolt Orbán (technological expert)

*“We have to create more than a hundred e-learning study materials. Our team designed and coded a programme that automatically generated e-learning materials, so we were done. We just had to press the Enter button”.*

Vitéz Nagy (technological expert)

The fourth professional group in the EMC was the group of **curriculum writers**. The term “curriculum writer” was used during the development instead of “an instructor”, keeping in mind that in some cases, the teachers and curriculum writers are different actors in public administration. The best experts or leaders were asked to write the curriculum while other teachers occasionally were asked to teach their materials. They were responsible for providing the correct input content. Methodological and technological experts provided organised training for them to present what would happen to their scripts. With that understanding, they would prepare the best possible e-learning input. Probably, this collaboration proved to be the most sensitive and significant for the success of e-learning development.

## 4.1. Success Factors of the Designing Process

Although creating standards for information quality is critical, it is a complex issue since there is no formal definition of information quality; instead, it is decided by the criteria used to assess it. Moreover, it is based on the objectives, the environment, and who we assess information quality from, the supplier's or the customer's perspective [Alkhattabi M., Neagu D., Cullen A., 2010].

In universities, for example, excellent teaching and learning are emphasised as a primary priority, with less emphasis on criteria or metrics related to instructional input into courses, learning outcomes, and system interactivity [Crisp G., 2002]. Another trend is to think about quality improvement by moving beyond a set of concepts and toward flexible negotiating procedures that require a high level of quality capacity from those engaged [Ehlers *et al*., 2005].

Higher education has mainly established quality e-learning or blended learning methods. According to the research, these models are frequently conceived from the standpoint of the suppliers. From students' perspective, what is crucial for the quality of e-learning or blended learning has lately gained considerable attention in the literature. Stakeholder consensus on students' quality demands is beneficial for facilitating conversation amongst professionals to implement strategically e-learning or blended learning while ensuring that students' needs are satisfied [Blieck Y. *et al*., 2018].

Quality may be assessed and evaluated in a variety of ways. In this perspective, the SunTrust Equitable study depicts the value chain in e-learning as a pyramid [Close R. C., Humphreys R., Ruttenbur B. W., 2000]. Content is the most important aspect of e-learning since it is the foundation of the value pyramid. To utilise the Internet to boost learning, the information must not distract learners but raise their desire to study. In the learning process, learning aids and facilitators are also crucial. In reality, learning platforms and knowledge management systems are critical to content delivery success. Infrastructure is required for the delivery of learning content by the suppliers. Learning service providers (LSP) are also content producers' distribution channels. One challenge is that these knowledge hubs and LSPs confront to ensure that learners receive new content [Alkhattabi M., Neagu D., Cullen A., 2010].

An e-learning platform should focus on four key elements: **learning environment, learning support, learning motivation and assessment transformation** (Figure 47) [Neusoft, 2017].


Figure 47. Main elements of an e-learning platform [Neusoft, 2017].

Student management, enrolment, forums, student communities, virtual classrooms with schedule publication, reservation of classes, content libraries, and tools to personalise and create your own content should be included in e-learning platforms. It is important to register and track a student's progress to address any shortcomings that learners may have. The e-learning platforms should collect a wide range of data in order to display it in comprehensive reports that would otherwise take the teaching staff many hours to accomplish. Automatic assessment is the star of online learning platforms when it comes to saving time for teachers. These serve two main purposes: the automation of the correction and the data recording. Because the information is kept in the cloud and managed through a collaborative work system, it can constantly be updated and made available to students. Teachers may develop, update, and publish information in a flexible manner [Barquero J., ].

Figure 48 presents basic features of a learning management system, called by others a learning platform [].

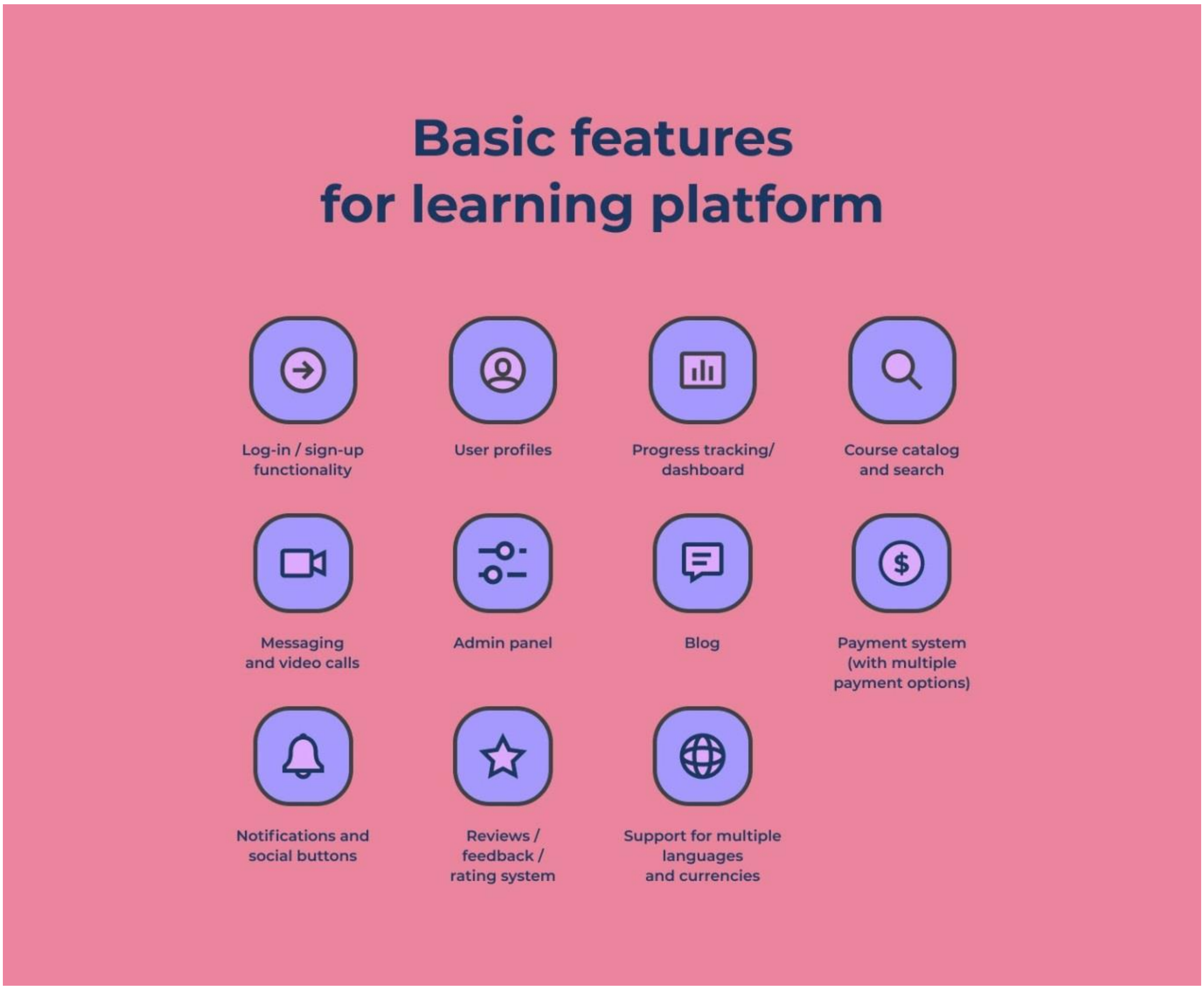



Figure 48. Features for an e-learning platform [].

To develop a successful online teaching programme, facilitation skills, learning design, and knowledge creation assistance are necessary [De Laat M. et al., 2007]. Facilitation, however, may be distinguished from the other two. Learning design is guided by the teacher's decision on learning tasks, curriculum structure and assessment [Conole G., 2013]. Knowledge building support or "content facilitation" [Goodyear P. *et al*., 2001] "refers to a teacher's ability to promote students' epistemic fluency. Measuring learning outcomes that result from effective facilitation is challenging because they fall within the socio-emotional domain" [Poquet O., Dawson S., Dowell N., 2010].

Figure 49 summarises the critical e-learning success factors found essential during the development process and collaboration of the professional groups. These categories were developed based on the experiences of leaders, technology, method and curriculum experts.

Sometimes, detection of the negative factors was the primary concern because managing it was the best method to steer the development.

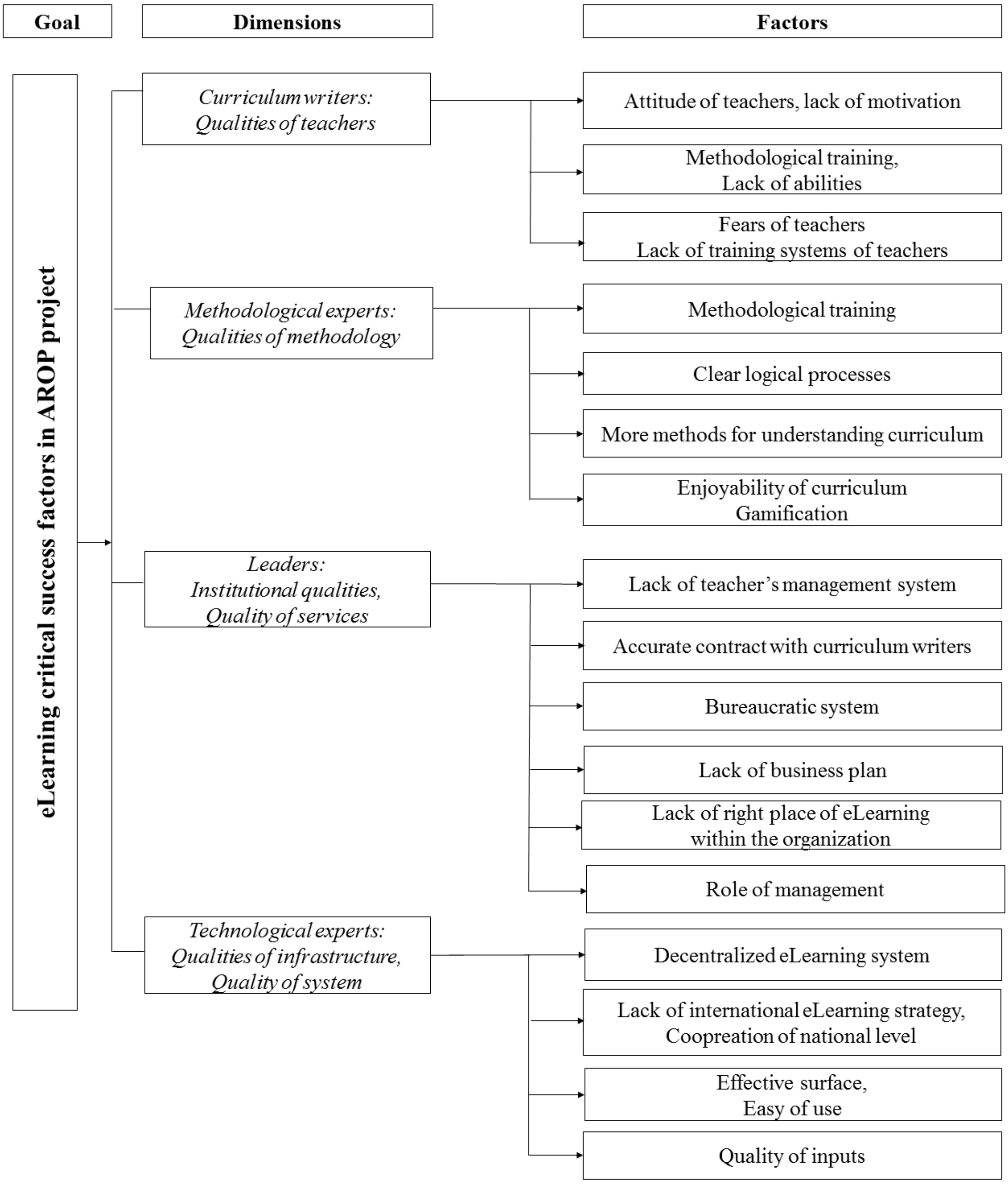



Figure 49. Critical e-learning success factors [Nemeslaki A. et al., 2014a].

A training system is effective when it runs a series of activities related to the formulation of educational policy, the securement of financial resources and infrastructure, the definition of staff members' obligations, the coordination of educational activities across the organisation, and the monitoring of educational system's functioning [Hegewisch A., Brewster C., 1993; Papalexandri N., Bourantas D., 2002; Dessler G., 2012].

Curriculum writers' input included the teachers' attitudes, lack of motivation, methodological preparation, and sometimes, lack of capacity and the teachers' fear.

Methodological experts drew attention to the need for methodological preparation, the strategic importance of the process, several solutions offering better understanding and awareness of gamification.

Leaders' section includes two major categories: institutional characteristics and service quality, such as lack of teacher management system, formal contract with the curriculum writers and the importance of a solid business plan. Leaders drew their attention to strategic processes and the need for long-term objectives. Communication of results, issues and goals is also proved essential amongst stakeholders.

Technological experts highlighted the importance of infrastructure and the quality of IT systems. Continuous system development is necessary under changing needs to help the work of methodological experts and curriculum writers.

*"In this process, there are many elements, which are a great challenge for participants. Cooperation is very important. I would like to highlight a few influential elements in every group: the communication and cooperation in the case of leaders, the use of methods in the case of methodological experts, the right input according to quantity and quality in the case of technological experts, the attitude toward training in the case of curriculum writers".*

Eszter Monda (research fellow)

## 4.2. e-Learning in Public Administration, ÁROP Project

In the ÁROP 2.2.19 project, over 100 video-based e-learning materials were created for Hungarian public administration workers. As a result, several hundred fully complex videos with interactive elements were produced. On the one hand, making these new materials was the development of new methodologies, and on the other hand, it was a technologically exciting challenge [Orbán Z. *et al*., 2015].

The members of the development team put great emphasis on becoming more familiar with the various forms of e-learning, introducing  v3.0 motivation methods (e.g. gamification), the observation of learning habits, consistency and the use of virtual tutors for coordination. The diversity of the project was guaranteed by the cooperation of participants with different professional backgrounds (IT, pedagogy, public administration, team leadership, content development, animation, etc.) [Nemeslaki A. *et al*., 2014a].

Some of the most important factors influencing the positive development of public administration are closely related to the technological rethinking of administrative processes that we associate with the notion of e-government. The European Commission defines e-government: as "the use of ICT in public administrations combined with organisational change and new skills in order to improve public services and democratic processes and strengthen support for public policies" [Eur-Lex, 2006]. This specifies that ICT needs to be accompanied by organisational and personal input to gain added value in the outcome [Orbán Z. *et al*., 2015].

The new public servant training programme started in 2014. The basics of the new system include training planning, required training and collecting credit points. More than 75,000 public servants take part in the training programme from all over Hungary, who are different in many aspects, such as geographical, age, education or job categories. Developing and maintaining such an enormous system is a big challenge, so it needs the involvement of methodology from the field of electronic training methods [Illéssy M. *et al*., 2014].

The National University of Public Service intended to accomplish the training with significant e-learning support. Complex methodological and technological developments were realised in the ÁROP-2.2.19 project "Creating Electronic Training and Distance Learning Materials". A new e-learning format was developed for both the university and the public servant training programme. By using this new method, 75,000 public servants learn and take exams in 100 training programmes, each containing 4-7 video-based e-learning materials. The e-learning material won the first prize in 2014 at the INFOTÉR conference [INFOTÉR, 2014], on the eFestival excellent Hungarian content in the education category [Orbán Z. *et al*., 2015].

### 4.2.1. Methods

<u>Receipt of the training directive</u>

The first step of progress is the submission of the customer's directive for training to the E-Learning Methodology Centre (EMC). Due to the comprehensive objectives of the project, the EMC is intended to serve the public service e-learning needs in the long term. This meant, that while planning the human resources and the infrastructure, the working group was prepared, that within the project named "2.2.19" the training directives incurred not only by the University or other related organisations but also from the project named "ÁROP" (in short terms) and several other public service organisations' needs (in long terms).

<u>Needs assessment among the targeted group</u>

The preliminary plan was to conduct a complete survey among the targeted group considering their level of knowledge, competence and attitude by using assessment centre interviews and qualitative methods in the focus group. The purpose of the survey was to create well-customised solutions and relevant content to raise and maintain learning motivation.

<u>Requirement specification</u>

In the third step, the methodological team of EMC prepares the training and programme funding and programme-developing document (PDD). The PDD comprises the training output requirements (TOR), the training's targeted group, the necessary resources, the resource plan, the scheduling and deadlines of the development and other specifications (e.g. the need for validation from a focus group for the e-learning development).

The training PDD was accepted by the Program Steering Committee (PSC), which consisted of the following experts: EMC pedagogical/didactical expert, EMC technological expert/production manager, training organising coordinator, field specialist (external contractor) and project manager.

Selection of the e-learning material's authors

The project management team selects the e-learning material's authors based on the training PDD. This means that they revise the tenders, choose the authors and perform the contract with them.

Methodological preparation

The methodological preparation of the authors and scenario writers takes place in a 2 x 6 hour-long workshop organised and held by the methodological team of EMC. This step might be considered the most crucial part of the process. The authors need to be prepared for a new field with very different rules than traditional education [Clark R. C., Mayer R. E., 2007].

The syllabus of the workshop is the following [Orbán Z. *et al.*, 2015]:

- day 1 – general preparation: the know-how of producing the scenario document, basic rules, editing frameworks, boundaries and possibilities,
- after day 1, all the authors must create the ontological map for their study material independently; this map is a planning document, which shows the context of the e-learning material to be developed,
- day 2 – interactive professional forum: consultation with the e-learning authors; they can discuss the ontological map with the pedagogical/didactical and the technological/IT experts from EMC; the experts also help the authors with further information, advice, and suggestions.

Customising the scenario template

The output of the methodological preparation workshop is a scenario template for all the involved learning materials, which contain not only the standard formats and expectations but the author's specific ideas and suggestions for the e-learning material.

Creating the scenario

Based on the scenario template, the authors are expected to create scenarios for the e-learning material. The didactical, methodological, technological and IT experts from EMC provide continuous support during the process.

Validating the scenario and creating the production plan

A field specialist lector does the professional validation of the finished scenario, and the methodological experts from EMC do the methodological validation. A grammar lector also corrects the scenario. The production management division from EMC creates a production plan, which sets technological and IT specifications for the producer colleague. The production plan also includes guidelines on which element of the e-learning production can be solved with internal resources and which parts are needed to be outsourced.

Outsourcing

When necessary, the project management team orders the workflows from external supplier companies based on the production plan. During the resource planning of the production process, it must be considered that scheduling the production is quite hard to plan, and some e-learning production processes can run parallel. The plan was to sign contracts with multiple suppliers to ensure flexibility so quick and efficient production could be granted, even in peak usage periods.

The production and testing of the e-learning material

The production process is performed by the e-learning development team of the EMC or external suppliers. On behalf of the EMC, the technological expert/production manager handles the production process.

Validating and checking the e-learning material

The e-learning material validation is done using focus group testing. The to-be users (who are public servants) provide direct feedback about the content, the usability and the efficiency of the e-learning material in a group interview. The PSC makes the final approval of the e-learning material.

Creation of the course, course management

A course is an interface provided by the e-learning system, where the e-learning material is available for students. It also offers several additional opportunities for complementary content (e.g. glossary, collection of videos, the repository of links, etc.), communication (forum, chat room, internal messaging platform, blog, etc.), and evaluation (submission forms, practising and final exams, grading). Unlike the e-learning material, a course requires quick, even daily updates and control from the instructors, depending on the type of education. In the context of the course management, the technological expert/production manager from the EMC creates the platform (uploads the finished and validated e-learning materials, makes the additional complimentary content, communication and evaluation tools). Later, the course is continuously updated and maintained by the tutors, which includes answering questions by students, evaluating their work, etc.

Training recruitment, conduction of the training

The training recruitment is performed by the coordinator of the training organiser defined by the TOR in the PDD.

Impact assessment analysis

The tools of the impact assessment analysis are the following [Orbán Z. *et al*., 2015]:

- framework statistics: logs, which show the time spent studying, the results of an exam, etc.,
- measuring customer satisfaction: built-in questionnaire in the framework and focus group surveys,
- measuring knowledge expansion: depending on the training nature, it is performed by outside interviewers under the coordination of the methodological team's research leaders of the EMC, or it is measured by pre- and post-testing, which aims to measure the integration of the learned curriculum,
- ethnographic interviews: the standard research (qualitative and quantitative methods) pitfalls can be avoided with this methodology. The interviews take place in real-life situations, not in artificially generated circumstances; it combines interview and

observation, which mostly avoids the inaccuracy caused by the low motivation of the respondents by using the "instant indulgence" technique.

As shown in Table 8, several types of courses were created due to the requirement specifications, the nature of the content, the most appropriate learning style and the opportunities provided by the technology. During the material design process, some innovative software solutions were developed, such as animation, green-box video presentations, creative testing modules, role-playing animation – some of them stretching the technical and learning infrastructure – but most of them executing a stable script according to Table 9.

Table 9. Typical course designs as final artefacts [Nemeslaki A., 2016].

| **Typical course (8 types)** | **Type of learning** | **Type of e-learning** | **Type of Content** | **Learning innovation** | **Target Group** |
|---|---|---|---|---|---|
| **Public Administration Institutional Procedures** | e-learning | video presentation | knowledge transfer | high level | Employees |
| **Introduction to the New Civil Code** | blended learning | static material | knowledge transfer | n/a | Employees |
| **Energy Policy** | e-learning | video presentation | knowledge transfer | medium level | Mixed |
| **Financial Management in Local Governments** | e-learning | video material, only sound | knowledge transfer | low level | Mixed |
| **Project Management** | e-learning | animation based material | skill development | n/a | Managers |
| **Basic Exam Preparation for Public** | traditional classroom learning | n/a | knowledge transfer | n/a | Mixed |

| | | | | | |
|---|---|---|---|---|---|
| **Service Employment** | | | | | |
| **Public Procedure – Case Studies** | e-learning | atypical animation (role-playing) | knowledge transfer | n/a | Managers |
| **Organisational Communication** | blended learning | n/a | knowledge transfer | n/a | Mixed |

When these courses were tested, the following order of preference of learning methods was reported by 880 respondents: 1) visual demonstrations (pictures, videos, animation), 2) text-based learning, 3) classic lecturing with clear speech, 4) action-oriented active learning (exercises, creative simulations, drama). Naturally, the preferred transfer of knowledge was also a determining factor. For instance, a skill-building project management course required different elements than transferring the content of the new Hungarian Civil Code. As far as requirements for the successful adoption of the courses are concerned, **users showed the following order of preference: availability of a tutor, having possibilities to ask personal questions, delivery of classic lectures, availability of video-based materials, and opportunities to download the material during the study.** These preferences are typical for Hungarian continuous education. They align with a somewhat passive attitude towards learning, preferring easily digestible, classic lectures versus active engagement during the learning process. The development team identified that access to the courses was 58% from workplace computers, 36% from home using regular PC-based infrastructure, and only 2% indicated tablet and 1% mobile access preferences [Nemeslaki A., 2016].

Table 10 shows the development results of several courses, the type of content and the total number of hours. Public policy type of content has been the majority and e-government type the lowest proportionally compared to the total number.

Table 10. Results of the e-learning course development - the situation in 2015 [Nemeslaki A., 2016].

| | Topic | Course Types | Course number | Course % | e-Learning hours | Hours % |
|---|---|---|---|---|---|---|
| 1 | Public Administration Basics | constitutional basics, institutions, strategies, decision and control, PA procedures, simplification, reform initiatives | 15 | 14% | 1553 | 15% |
| 2 | Public Administration and Legislation | legislative norms, codification, checks-and-balances, international law, courts | 10 | 9% | 460 | 4% |
| 3 | Public Administration in the EU | institutions, decision making in the EU, EU public policies, legislative basics | 5 | 5% | 254 | 2% |
| 4 | Local Governance and Regional Development | local and self-governance, the regional policy of Hungary, institutions, local and central governance | 9 | 8% | 1310 | 13% |
| 5 | Public Finances | fiscal and monetary policies, budgeting, controlling, asset management, state budget legislation | 10 | 9% | 741 | 7% |
| 6 | Organisational and HR Management | communication, motivation, performance evaluation, integrity and corruption, HR management, organisational culture, labour law, innovation | 13 | 12% | 1282 | 12% |
| 7 | Government Services and Efficiency | services, processes, quality, procurement, efficiency, logistics, project management | 8 | 7% | 1126 | 11% |
| 8 | E-government | government ICT, data registers, privacy and security | 3 | 3% | 182 | 2% |
| 9 | Public Policy | economic, employment, healthcare, education, national, trade, energy, inclusion, social | 20 | 19% | 2533 | 24% |
| 10 | Special Fields of Administration | education, tax, customs, social, environment, healthcare, pension, rural | 15 | 14% | 1022 | 10% |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | development, construction, agriculture, etc. | | | | |
| | **TOTALS** | | **108** | **100%** | **10,463** | **100%** |

### 4.2.2. e-Learning Methodology in the ÁROP Project

In a regular setting in Hungary, the average time is 45 minutes that students spend in the classroom. Interestingly, **it is about 7 minutes when we can listen and concentrate actively while learning**. In e-learning, it is easier to solve and manage this timeframe because videos and e-learning materials can be cut into 7-minute-long parts. By using e-learning, the entire learning process can be changed to be more effective than it is traditionally.

ICT helps to check results, what is in the head of students, while data files can be generated with every mouse click or keystroke. Using these processed data generated during the learning process, one can create a better curriculum and educational resources.

Based on the findings of the problem statement section, the EMC team has visualised a complex structure for e-learning, which served as a guideline for development and to capture the intertwined relationships of technology-knowledge-actor-process – and called it the e-learning eco-system (Figure 49). The stability of the end-product and its final assessment depends on how the interaction works between human actors (teachers, learners, administration, software engineers), the concept of learning (style, interaction, testing), how knowledge is embedded in the course (terminologies, concepts, skills), how this content is represented in concrete ICT solutions (text, picture, video, simulation, web-links) and how effectively the development/updating process is working [Nemeslaki A., 2016].

Figure 50 summarises the most important elements discovered, developed, or simply resolved during the "Development of Electronic Training and Distance Learning Materials" project. Under each component, there were further methodological, technological, or scientific challenges.

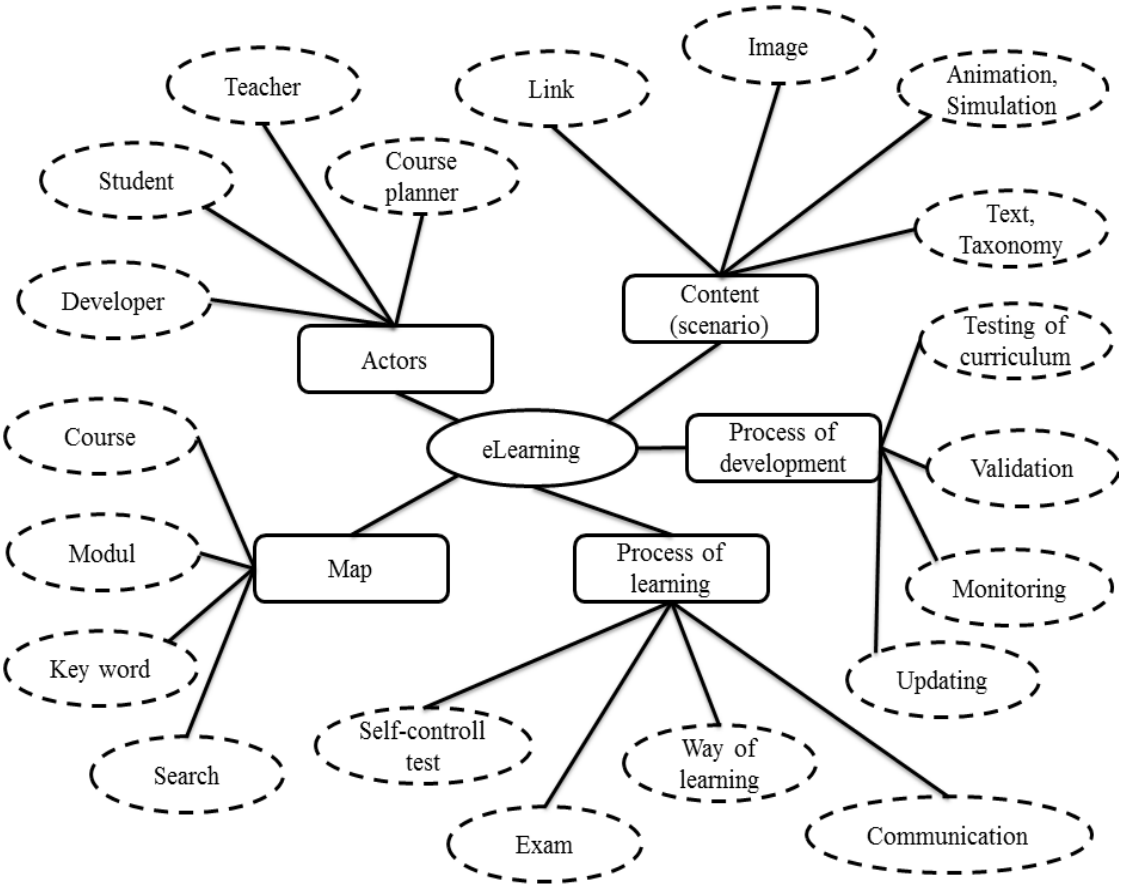



Figure 50. Elements of e-learning [Nemeslaki A. et al., 2014a].

For coping with the diversity of actors – both human and non-human – a platform was created by the EMC team, which uniquely combined processes and conversations between actors. First, knowledge content, learning styles, people, technology, learning audience changed, sometimes even within course units, so process cycles, communication dialogues, documentation should have been altered frequently. Second, e-learning courses had to be designed in tandem with the evangelisation of actors, often when opportunities of the technologies were not known to human actors or course content was highly unstructured. This situation is atypical in classic software engineering, where solutions can be provided when the scope is set clearly (functionality is decided and fixed). Processes and functional elements of the platform are presented in Figure 51 [Nemeslaki A., 2016].

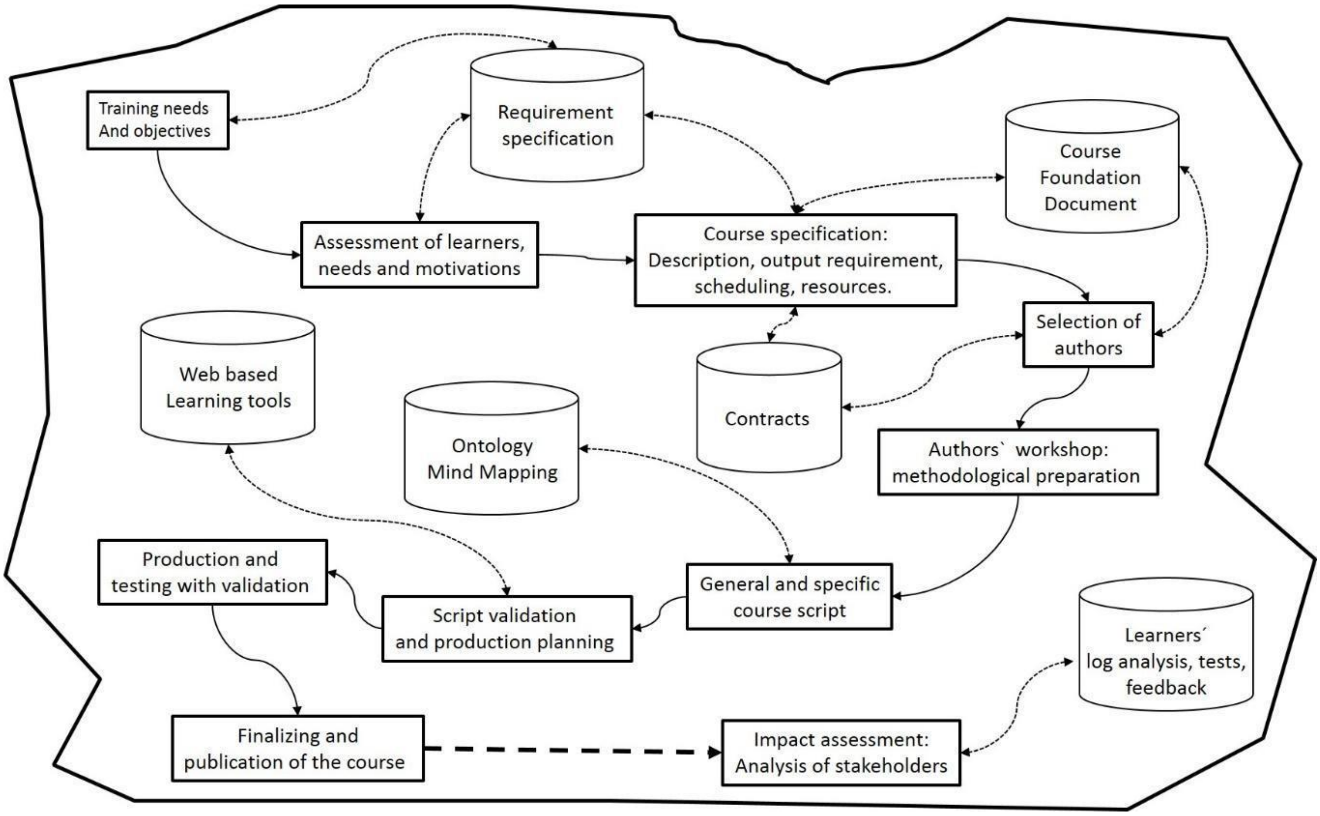



Figure 51. Process and Communication Platform for e-learning development – [Orbán Z., Nagy V., Balkányi P., 2015].

### 4.2.3. Constructing e-Learning Materials

Due to the high number of authors and related files, a platform was created in the e-learning system where the authors could find methodological guidelines, fora for asking questions and submission forms for uploading their work. The methodological team of EMC validated the submitted documents so that the production could begin.

However, this phase became more complicated than initially thought because of the following reasons:

- high quantity of the e-learning materials: the need to create hundreds of e-learning materials because each training programme (out of the 100) consisted of 4-7 modules,
- diversity of the components: in addition to the author's files, one needed to process the studio recordings, the written subtitles, codes, etc. Figure 52 presents the ingredients for one module.

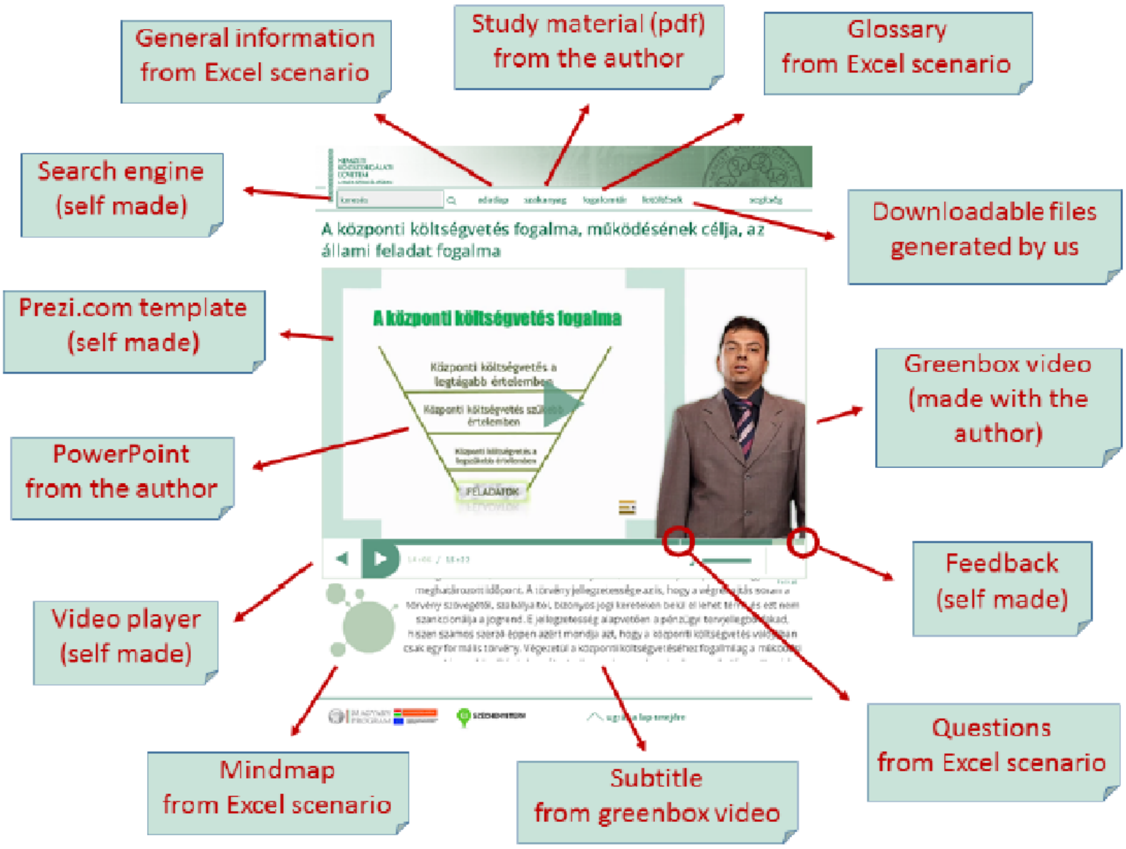
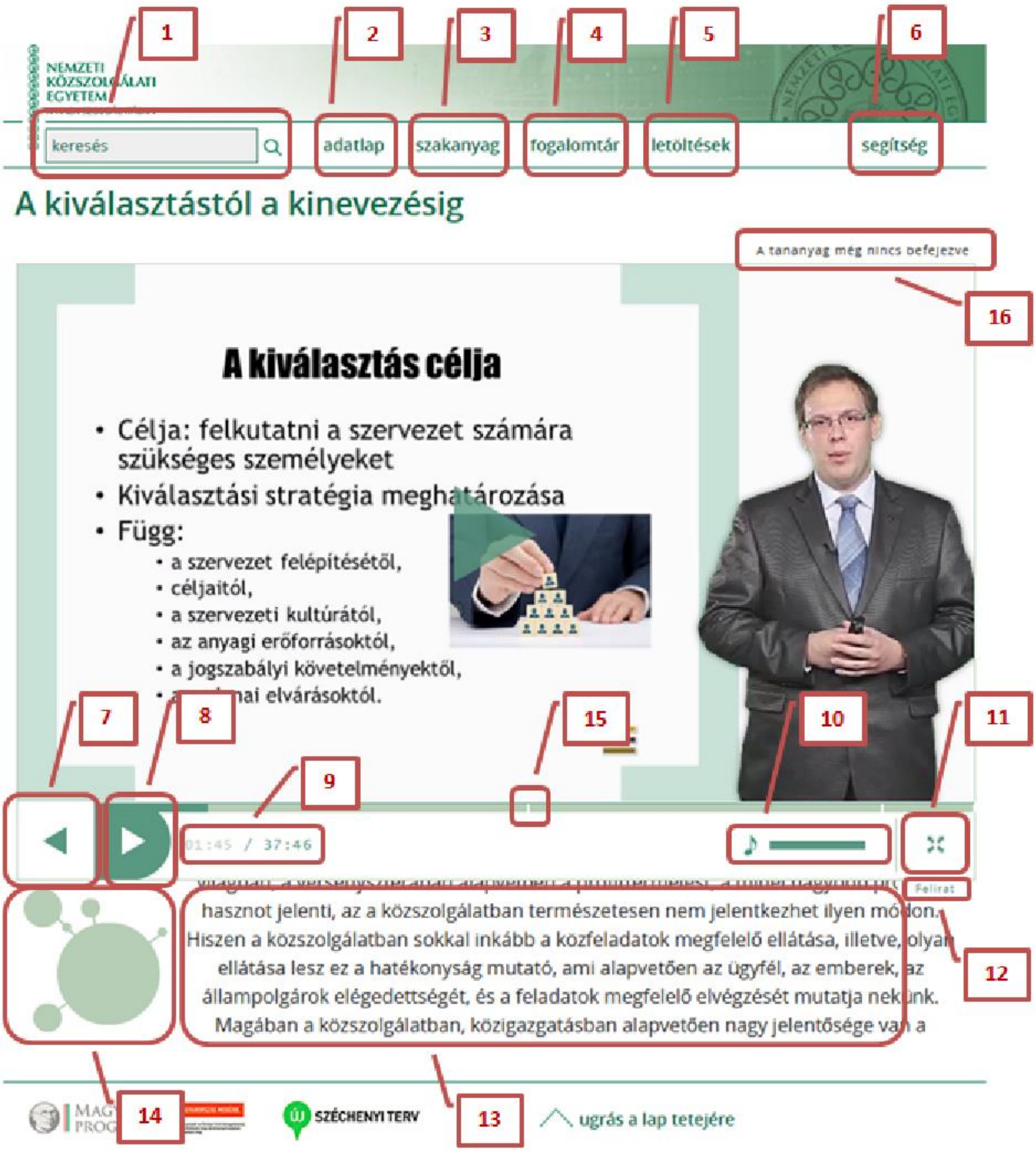



Figure 52. Presentation of components of one e-learning module [Orbán Z. et al., 2015].

These components came typically in different extensions, formats and ways because the suppliers for these elements were other companies or organisations without any links between them. Managing this process and daily communication with about a hundred different e-learning materials with up to 10 suppliers is already a considerable challenge, but producing hundreds of e-learning materials manually became a real challenge because of the lack of available resources. That is why it was decided to rearrange resources and create an automatic (visual basic based) technique for producing the content. The programme transforms the PowerPoint presentations into Prezi format, which is then mixed with the green box video. The necessary codes (html, json files for the framework and intermitting questions) are also generated alongside them automatically [Orbán Z. *et al*., 2015].

The most standard output of design based on research results is depicted in Figure 53. This view contains those functionalities which the final users experience, such as the screen layout, navigation buttons, multimedia content, basic monitoring and control elements.




| | | | |
|---|---|---|---|
| 1 | Search bar | 9 | Time bar |
| 2 | Course outline | 10 | Volume control |
| 3 | Course text (pdf format) | 11 | Fullscreen mode |
| 4 | Glossary | 12 | Subtitle button videos and speech |
| 5 | Downloads | 13 | Transcript of videos or speech |
| 6 | Help | 14 | Course Mind Map |
| 7-8 | Navigation buttons | 15 | Quiz Marker in the Time Bar |
| | | 16 | Status Indicator for completion |

Figure 53. Description of the final e-learning product [Orbán Z., Nagy V., Balkányi P., 2015].

## 4.3. Results

The following table summarises the planned workflow of e-learning material development and the organisation of the related training programme (Table 11).

Table 11. Overview of the workflow of e-learning material and the training programme organisation [Orbán Z. et al., 2015].

| Input | | Activity | Output |
|---|---|---|---|
| 1. | a) ‘2.2.19’ directive (University),<br>b) ‘2.2.19’ directive (external),<br>c) other ‘ÁROP’, or public service organisation’s directives (later) | Declaring training need | ‘2.2.19.’ or other ‘ÁROP’ support contracts |
| 2. | a) methodology team of the E-learning Methodological Centre (EMC),<br>b) outside contributor evaluator | Needs assessment among the target group | Specification of the directive |
| 3. | Program Steering Committee (PSC):<br>a) EMC methodological team (pedagogical/didactical and technological experts/production managers),<br>b) training organiser coordinator,<br>c) field specialist,<br>d) project manager | Declaring the requirement-specification | Training & programme funding and programme developing document (PDD):<br>- description of the training target group,<br>- training output requirements (TOR),<br>- scheduling and resource plan |
| 4. | Project management team | Selection of the authors | Expert tenders, contracts |
| 5. | Methodological team of the EMC | Methodological preparation | 2x6 hour-long workshop |
| 6. | Methodological team of the EMC | Customising the scenario template | Scenario template |
| 7. | Authors, other contributors (experts) | Creating the scenario | Scenario |
| 8. | a) Field specialist and grammar lector (can be an outsider),<br>b) Methodological team of the EMC | Validating the scenario and creating the production plan | a) Validated scenario<br>b) Production plan |
| 9. | Project management | Outsourcing | Suppliers |
| 10. | a) Technological experts and production managers from EMC<br>b) Production team | Production and testing | e-Learning material |
| 11. | a) Focus groups,<br>b) PSC | Validating and checking | a) Result of the focus group testing,<br>b) Approved e-learning material |
| 12. | Methodological team of the EMC | Course creation, course management | e-Learning course |
| 13. | Coordinator of the training organiser from VTKI | Training recruitment, conduction of the training | List of candidates for training, list of completion |
| 14. | a) Methodological team of the EMC,<br>b) External supplier | Impact assessment analysis | a) Usage statistics,<br>b) Satisfaction results,<br>c) Measuring the expansion of knowledge |

According to the empirical research, as Table 12 shows, **e-learning has proven the most preferred alternative for education among Hungarian public servants** [Nemeslaki A., 2016].

Table 12. Preferences of learning amongst Hungarian public servants [Nemeslaki A., 2016].

| **Rank** | **Method of learning** | **Indication as first place in the ranking** (n=900) |
|---|---|---|
| 1. | E-learning | 52,9% |
| 2. | Class-room learning | 31,1% |
| 3. | Blended learning | 13,5% |
| 4. | Executive style training | 2,5% |

This positive attitude was not moderated either by age, qualification, or time of employment. Furthermore, 74% of the same respondents (n=900) indicated positive interest in e-learning opportunities, while only 5% reported a lack of interest, and 8% had some level of concern.

Table 13 shows four clusters of Hungarian public servants identified according to their attitude towards e-learning [Nemeslaki A., 2016]:

a) **Career-oriented**: The group with diverse motivations is open to learning and recognises its many folded benefits. This group views it as the main driver for career development, better performance at work, and gaining knowledge **(39% of respondents)**.
b) **Negligent**: Members of this group do not believe in continuing education, do not see benefits, neither for career nor better work performance. They never feel they would learn anything. Training is a major hassle for them **(11% of respondents)**.
c) **Open**: This group is not open to career (anymore) but enjoys training and sharing knowledge and/or increasing work performance **(21% of respondents)**.
d) **Passive**: Members of this group have similar behaviour as the negligent, but they are not as negative as the previous one; they are relatively inactive and low motivated or see a slight benefit for their career management in learning **(29% of respondents)**.

Table 13. The cluster of public servants according to their e-learning attitude [Nemeslaki A., 2016].

| | **Oriented** | **Negligent** | **Open** | **Passive** |
|---|---|---|---|---|
| Beginner | 41% | 5% | **9%** | **45%** |
| Experienced young employee | 35% | 10% | 18% | 37% |
| Young inexperienced in public administration | **50%** | 5% | **12%** | 33% |
| Experienced middle aged | 39% | 11% | 20% | 30% |
| Not too young and inexperienced in public administration | 46% | 10% | 26% | **18%** |
| Advanced age public administration employee | **33%** | 14% | **30%** | **23%** |
| TOTAL | 39% | 11% | 21% | 29% |

## 4.4. Conclusions

There was a commitment to teaching material development, initiating a Hungarian “MOOC environment” in public service education, and investigating the setting of effective development methodology with the ÁROP 2.2.19. “E-learning Development Project”.

In the E-Learning Methodology Centre, it was established a creative working environment for four professional groups – **project leaders, methodology experts, IT developers and curriculum writers** – “which ensured that over 100 different e-learning materials were developed, tested and published for the Hungarian civil service continuing education” [Orbán Z. *et al*., 2015]. The multidisciplinary cooperation turned out to be efficient in creating many high-quality e-learning courses in a relatively short time.

A counter-intuitive finding from Table 13 is that denial or acceptance of e-learning is not dependent on age or experience. A negative attitude towards online courses is evenly distributed, while positive is mainly amongst the young and not too young public servants.

Two important empirical arguments support the **need for investigating e-learning development as a local effort. First, courses should be practical, relevant to the learners´ particular work circumstances and skill requirements. Second, content should be up-to-date regarding the legal regulations, organisational players, and specific situations of institutions.**

The presented case describes how the dedicated E-Learning Methodological Centre created an e-learning design environment, including **methodology, e-learning content, IT infrastructure - integrating several ICT systems and tools - learning management systems, web development tools, databases, the key stakeholders and their unique technology frames.**

The above case presents the relevance of social construction concepts to implement successfully the e-learning modules into training programmes [Bijker W. E., 1995; Wang M., Vogel D., Ran W., 2011]. This approach is vital because civil servants work in legally and socially rich environments where technology-based solutions can only be productive if deployed with the proper consideration or “fit” of technology, culture and organisation.

This submission intends to enrich the public ICT research field in three areas. First, the case might serve as a practical example for producing public service e-learning courses on a mass scale, enhancing public workers’ knowledge and skill-building, elevating digital literacy, and immersing ICT in public service development. Second, regarding design science research, the case shows how SCOT constructs to explain the process of technology acceptance and the closure of adoption. With this, it illustrates how artefacts can be built which have rich social and cultural contexts. Relevant social groups (leaders, methodological experts, programmers, instructors and scriptwriters) have different technology frames to address the relevant issues. Third, the case intends to enhance our understanding of the ICT – organisation relationship. Integration of action research foundations with design science seems to be a promising direction worth exploring in other areas of public IT applications.

## Chapter Summary

The third chapter focuses on the success factors in designing e-learning courses and the collaboration between experts from different backgrounds (project leaders, methodology experts, IT developers and curriculum writers) in creating such courses. There is a detailed description of the e-learning methodology used in the ÁROP project, the process of constructing e-learning materials for public servants and the training programme organisation. There is also presented feedback about e-learning courses gathered from Hungarian civil servants who take part in e-learning courses as part of their continuing education.

# 5. EFFICIENCY OF E-LEARNING IN CONVEYING KNOWLEDGE

For pharmacists and other healthcare professionals, e-learning is fast becoming a feature of undergraduate courses as an addition to on-site learning activities [Brown M. C. *et al*., 2007]. Adult learners are believed to have higher motivation and capability for self-directed learning, and the blended approach may be more appealing to them [Teeley K. H., 2007]. There are also interdisciplinary online partnerships in education and practice for healthcare professionals [Varga-Atkins T., Cooper H., 2005; Bury R., Martin L., Roberts S., 2006] and specific pharmacy post-graduate courses [Brandys J. *et al*., 2006].

Pharmacy continuing education using the e-learning approach is widespread and well developed in big countries like the USA, Canada or Australia. There are numerous e-learning platforms for pharmacists providing continuing education. In the United States, Postgraduate Healthcare Education (PHE) provides "Power-Pak C.E.® educational programs for the broad spectrum of healthcare professions. Professional medical and pharmaceutical education constitutes PHE's core activity. This mission is achieved through the company's ongoing continuing education activities. The primary goal of all continuing education programs is to provide, promote and disseminate topical education to all medical personnel and pharmacists to maintain and improve their knowledge and skills" [Power-Pak C.E.®, 2015]. The Accreditation Council for Pharmacy Education provides Continuing Education credits for the courses.

RxSchool is a one-of-a-kind e-learning solutions provider that effectively links healthcare professionals with top educational content suppliers. This website, powered by the RxSchool learning management system, has one of the biggest libraries of the Accreditation Council for Pharmacy Education certified continuing education on the Internet. Because of the combined efforts of RxSchool providers, educational institutions, businesses, organisations and the pharmaceutical industry, many of the courses are available for free [RxSchool®., 2016].

### Pharmacists continuing education in Poland

Following pharmaceutical law requirements in Poland, "every practising pharmacist must gain 100 educational credits during five years time span. The educational credit pool is subdivided into two groups – those with and those without an exam, so-called *hard* and *soft* credits. These continuing education credits are necessary to extend the professional license for the next period. Pharmacists need to collect at least 50 *hard* credits and 50 *soft* credits during a 5-years long period. The educational process remains under the control of accredited Centres of Postgraduate Education, working with the Local Pharmaceutical Boards. Every pharmacist has their own 'educational card' where the points are recorded" [Brandys J. *et al*., 2006]. In Poland, the need to take part in recognised continuing education courses is mandatory to maintain a professional license.

These days, over 80% of Polish professionally active pharmacists participate in e-learning courses. Four online platforms are offering accredited courses: 1) e-dukacja, the platform of Regional Pharmaceutical Chamber in Krakow (http://e-dukacja.pl/), 2) platform of Medical University of Lodz (http://www.e-umed.pl/**)**, 3) platform of Polish Pharmaceutical Society (https://www.szkolenia.ptfarm.pl/) [Nesterowicz K., 2012], 4) platform of the Pharmaceutical School of Management (http://www.e-aptekarska.pl/). The earliest one (e-dukacja) was launched in February 2005 [Mendyk A., Polak M., Polak S., 2009] and the latest (e-aptekarska.pl/) in 2013. Warsaw Medical University administered the online platform farmacja.edu.pl; however, there have not been accredited continuing education courses there since 2013 [Warsaw Medical University, 2013].

Online courses offered by platforms such as e-duk@cja.pl from Krakow and e-umed.pl from Lodz are at no cost. Other platforms provide most of their classes after paying the fee (Table 14).

Table 14. e-Learning platforms for pharmacists in Poland [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

| e-learning platform | Established (year) | Access to e-courses | Administrator | Registered pharmacists |
|---|---|---|---|---|
| e-dukacja.pl | 2005 | Free of charge | Local Pharmaceutical Chamber in Krakow | About 19,000 |
| e-umed.pl | 2009 | Free of charge | Medical University of Lodz | 7,523 (18 Sept. 2013) |
| szkolenia.ptfam.pl | 2010 | Mostly charged | Polish Pharmaceutical Society | About 1,000 |
| e-aptekarska.pl | 2013 | Mostly charged | Pharmaceutical School of Management | n/a |

Access to the above e-learning platforms is granted after user registration and data provision, including local pharmaceutical chamber and work permit number.

### e-Courses for Polish pharmacists offered by e-dukacja.pl

The e-learning platform e-dukacja.pl is the oldest and most extensive in Poland (Figure 54). It was launched in 2005. Pharmacists need to fill out an online application form to register for the system. Candidates receive the password to log in to the system from administrators in their mailboxes if they have completed the process satisfactorily. “After logging in, the user can sign up for a chosen course. Administrators of the platform decide within 7 working days on the acceptance or rejection of a pharmacist to the e-course. Access to courses is regulated by Local Pharmaceutical Chambers. Some of them expect regular payment of Chambers’ membership fee to enable entry to educational materials. After taking part in an e-course and passing a final test, users obtain certificates from the Centre of Postgraduate Education Faculty of Pharmacy Jagiellonian University Medical College in Krakow” [Nesterowicz K. *et al*., 2011].


Figure 54. Homepage of the e-learning platform for pharmacists e-dukacja.pl [www.e-dukacja.pl, 2016].

## 5.1. Tools to validate e-learning

In most countries, continuing pharmacy education is becoming obligatory to maintain a valid professional license [Rouse M. J. *et al*., 2016]. A growing number of professionals are using e-learning as part of their ongoing education. As a result, the growing popularity of this type of teaching necessitates standardisation and validation procedures.

**Knowledge test**

"To check the changes and/or increase in knowledge, participants are asked to answer a knowledge test about the content of the course before and after the educational intervention. The test is designed as multiple-choice questions, where each question includes one correct answer and three distracters. A correct answer scores one point, and an incorrect answer scores zero. The same test should be conducted online for the intervention group and on paper for the control group. The participants can sit the pre- and post-test online or paper test only once. After completing the pre-test, participants do not have access to correct answers" [Nesterowicz K., 2015].

**Questionnaire**

Questionnaires are frequently used research tools to obtain data about group processes [Webb N. M., 1982; O'Neil H. F. *et al*., 2000; Willis S. C. *et al*., 2002; Sy T., Côté S., Saavedra R., 2005]. Just as well structured interviews, so questionnaires can observe "relationship-oriented and task-oriented processes" [Urch Druskat V., Kayes D. C., 2000]. Questionnaires can be open-ended or closed-ended [Alavi M., 1994]. "Open-ended questionnaires are more closely related to a structured interview; the data collected using this format can be focused on group processes as well as group characteristics. Closed-ended questionnaires offer a limited set of responses. The limited responses involve some form of scale that could be nominal, ordinal, interval, or ratio. Data from this format have a limited ability to capture group process data, but this is the typical format for collecting data associated with group characteristics such as social space, group efficacy scales, group skills, group efficacy, group attitudes, group member roles, leadership and group knowledge. Data from questionnaires can be analysed, much like interview data, if the items are open-ended. If the questionnaire is closed-ended, then the instrument must be scrutinised for reliability before data analysis. Assuming sufficient evidence of reliability, analysing data from closed-ended questionnaires involves interpreting a measurement based on a particular theoretical construct. The types of data analysis techniques that are appropriate depend on the type of scale used in a questionnaire (nominal, ordinal, interval or ratio)" [van Gog T. *et al*., 2008].

An acceptance questionnaire can be utilised to determine the level of receipt of e-learning and on-site courses. It can comprise closed and open questions, using the Likert scale, some suggested answers or provide free text [Nesterowicz K., 2015].

## 5.2. Conveyance of Knowledge – First Study

I ran a didactic experiment to compare knowledge retention rates between e-learning and on-site learning. The posed research question was: **How does e-learning contribute to increasing the knowledge of learners compared to on-site education?**

According to Oxford Dictionaries, *knowledge* is defined as "acquaintance with facts, truths or principles, as from study or investigation; general erudition; the fact or state of knowing; the perception of fact or truth; clear and certain mental apprehension" [Oxford Dictionaries, 2016(a)].

### 5.2.1. Methods

**The course "Proper Monitoring of Blood Pressure and Chosen Laboratory Parameters Important for Patients with Hypertension" was offered as an e-learning course for pharmacists in an intervention group and as a face-to-face course for participants from a control group.** The course distributed by two learning modes had the same content. The intervention group comprised pharmacists trained through e-learning after registering to the e-dukacja platform, while the control group included pharmacists who received training in person. Participation in the research was voluntary. e-Courses, classified as instructional resources, and their associated assessments are evaluated by a scientific committee made up of three Jagiellonian University Pharmacy professors before being released on the e-dukacja platform. From March to July 2011, the on-site training was repeated for several groups during formal gatherings of pharmacists led by the Local Pharmaceutical Chamber, once at a conference on pharmaceutical care and once during the specialisation. All pharmacists were enrolled in the continuing pharmacy education programme to earn educational credits. The on-site training was offered as a two-hour session every time, and the same teacher conducted it. Pharmacists from community and hospital pharmacies and those who worked at pharmacy faculties and pharmaceutical wholesales were included in the study. The Jagiellonian University Bioethical Commission accepted the study, opinion number KBET/235/B/2010 [Nesterowicz K. *et al*., 2015].

In both learning modes, participants could interact with each other or with an instructor. In on-site courses, pharmacists had the chance to raise questions and discuss with a tutor and other participants in person. The e-learning platform included an online forum where any user could comment on the course, initiate a discussion or ask questions that other users or a tutor could read and answer. Moreover, each user had an internal mailbox to get messages from a tutor or send their messages [Nesterowicz K. *et al*., 2014].

**Knowledge test**

Participants were requested to complete a knowledge test regarding the course's content before and after the educational intervention to assess the changes in knowledge. The test consisted of 15 multiple-choice questions with one correct answer and three distractors for each question. A proper response received one point toward a total score of 15, while a wrong answer received zero points. The intervention group took the test online, whereas the control group took it on paper. Participants could only take the pre- and post-tests online or on paper once. Participants did not have access to right responses after completing the pre-test [Nesterowicz K. *et al*., 2015].

**Statistical tests**

There were several statistical tests chosen and used to match proper calculations:

1) **Wilcoxon signed-rank test** is a "non-parametric statistical hypothesis test used when comparing two related samples, matched samples or repeated measurements on a single sample to assess whether their population mean ranks differ (i.e. it is a paired

difference test). It can be used as an alternative to the paired Student's t-test, t-test for matched pairs, or the t-test for dependent samples when the population cannot be assumed to be normally distributed" [Lowry R., 1998].

2) **Mann-Whitney U test** (also called the Mann–Whitney–Wilcoxon, Wilcoxon rank-sum test or Wilcoxon–Mann–Whitney test) is "a nonparametric test of the null hypothesis that it is equally likely that a randomly selected value from one sample will be less than or greater than a randomly selected value from a second sample" [Wikipedia: Mann–Whitney U test, 2017].

3) **Kolmogorov–Smirnov test** is a nonparametric test of the equality of continuous, one-dimensional probability distributions that can compare a sample with a reference probability distribution (one-sample Kolmogorov–Smirnov test) or compare two samples (two-sample Kolmogorov–Smirnov test). The Kolmogorov–Smirnov statistic quantifies a distance between the empirical distribution function of the sample and the cumulative distribution function of the reference distribution or between the empirical distribution functions of two samples. The null distribution of this statistic is calculated under the null hypothesis that the sample is drawn from the reference distribution (in the one-sample case) or that the samples are drawn from the same distribution (in the two-sample case). "In each case, the distributions considered under the null hypothesis are continuous but are otherwise unrestricted" [Wikipedia: Kolmogorov–Smirnov test, 2017].

4) **Shapiro–Wilk test** is a "test of normality in frequentist statistics", first published in 1965 by Samuel Sanford Shapiro and Martin Wilk [Shapiro S. S., Wilk M. B., 1965].

5) **Chi-squared test (**$\chi 2$ test**)** is any "statistical hypothesis test wherein the sampling distribution of the test statistic is chi-squared distribution when the null hypothesis is true. Without other qualifications, the chi-squared test is often used as short for Pearson's chi-squared test" [Wikipedia: Chi-squared test, 2017].

6) **Analysis of covariance** (ANCOVA) is a general linear model which blends ANOVA and regression. "ANCOVA evaluates whether population means of a dependent variable (DV) are equal across levels of a categorical independent variable (IV) often called a treatment, while statistically controlling for the effects of other continuous variables that are not of primary interest, known as covariates (CV) or nuisance variables. Mathematically, ANCOVA decomposes the variance in the DV into variance explained by the CV(s), variance explained by the categorical IV, and

residual variance. Intuitively, ANCOVA can be thought of as ‘adjusting’ the DV by the group means of the CV(s)” [Keppel G., 1991].

7) **Spearman correlation** is a “nonparametric measure of rank correlation (statistical dependence between the ranking of two variables). It assesses how well the relationship between two variables can be described using a monotonic function” [Wikipedia: Spearman’s rank correlation coefficient, 2017].

**Statistical Analysis**

The IBM SPPS Statistics 19 and Statistica 10 were used to analyse the collected data. The statistically significant difference or correlation was determined using a two-tailed p-value of <0.05. Data was input into an Excel spreadsheet before being imported to SPSS. After that, using explorative commands for variables’ descriptions, the data quality was examined for outliers and errors.

The Wilcoxon signed-rank and Mann-Whitney U tests were used to compare the pre- and post-tests of knowledge within and across groups, respectively. The Mann-Whitney U test was applied to compare the age distribution between the two groups after the Kolmogorov-Smirnov and Shapiro-Wilk tests confirmed that the age distribution was normal. The frequency of each gender was compared between the two groups using the chi-square test. To adjust the age gap between groups and changes in knowledge, an analysis of covariance (ANCOVA) was used. Furthermore, the Spearman correlation was utilised to examine the knowledge test’s internal consistency by analysing the univariate correlation of each item with the sum of the test’s results.

## 5.2.2. Results

**Demographics**

The intervention group had 541 pharmacists, while the control group had 251. Women outnumbered men in both groups, with 85% (458 out of 541) and 89% (223 out of 251) participating in the intervention and control groups, respectively. There was no statistically significant difference in gender distribution across groups ($chi^2$ = 2.946, p = 0.0861). The intervention group’s average age was 39 years (SD = 11.04), whereas the control group’s average age was 45 years (SD = 12.79). The Kolmogorov-Smirnov and Shapiro-Wilk tests revealed that the age distribution was not normal ($p < 0.001$). **The mean rank of the age of attendees in the intervention group was significantly lower** (Z value = -5.82, $p < 0.001$), according to the Mann-Whitney U test. Figure 55 depicts the age stratification within each research group.

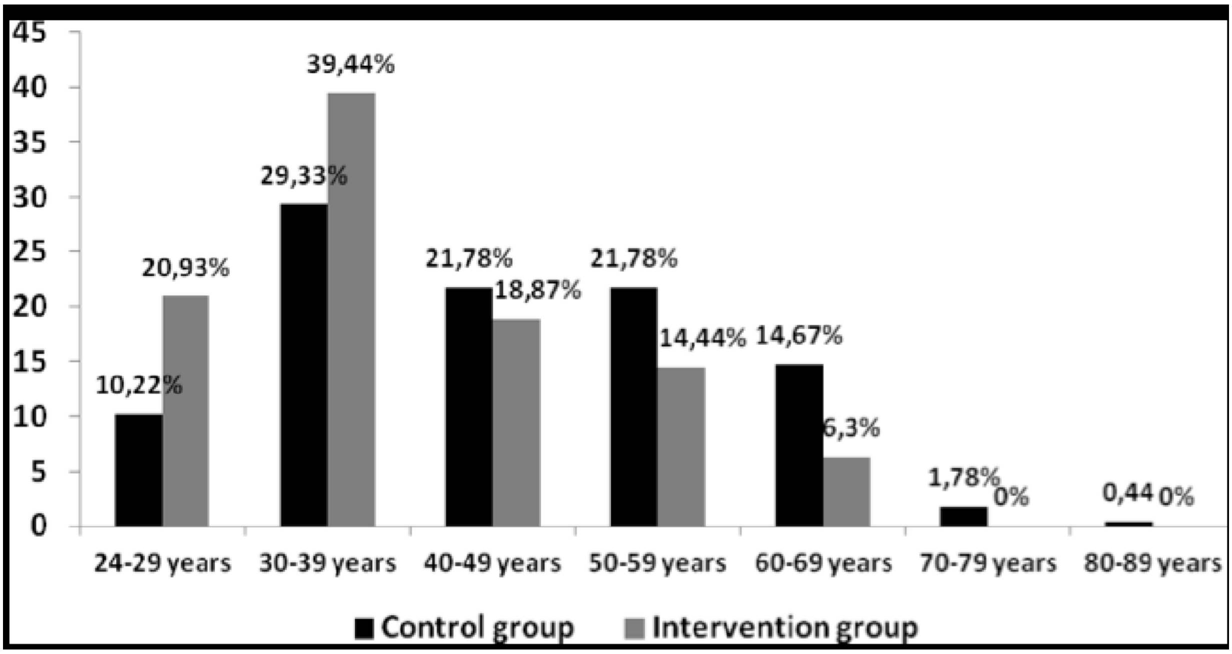



Figure 55. The stratification of the age of attendees in each study group [Nesterowicz K., Fereshtehnejad S. M., Edelbring S., 2015].

**Knowledge test**

The findings of the reliability analysis of the knowledge test by assessing the internal consistency of each item are summarised in Table 15. As indicated, most of the items showed a statistically significant correlation with the total knowledge pre-test scores in the control group.

Table 15. Spearman correlation of each item for internal consistency of the knowledge pre-test in the control group (n=251) [Nesterowicz K., Fereshtehnejad S. M., Edelbring S., 2015].

| ITEM | Spearman Rho | *P*-value |
|---|---|---|
| Item 1 | 0.380 | <0.001* |
| Item 2 | -0.108 | 0.132 |
| Item 3 | 0.413 | <0.001* |
| Item 4 | 0.209 | 0.003* |
| Item 5 | 0.342 | <0.001* |
| Item 6 | 0.171 | 0.017* |
| Item 7 | 0.116 | 0.103 |
| Item 8 | 0.313 | <0.001* |
| Item 9 | 0.174 | 0.015* |
| Item 10 | 0.163 | 0.022* |
| Item 11 | 0.094 | 0.188 |
| Item 12 | 0.222 | 0.002* |
| Item 13 | 0.481 | <0.001* |
| Item 14 | 0.216 | 0.002* |
| Item 15 | 0.184 | 0.009* |

* Statistical significant correlation ($p$<0.05)

"The mean of the knowledge score in the pre-test was 9.5 (SD=2.0) and 9.6 (SD=2.6) among the intervention and control group, respectively; no significant difference was observed (Mann-Whitney U: Z value= -0.314, $p$=0.753). **The increase of knowledge within each group before and after the course was significant** (Wilcoxon Rank: control group: Z value= -11.12, $p$<0.001; intervention group: Z value= -19.32, $p$<0.001). However, the **groups did not differ significantly in the change of knowledge** (Figure 56). The mean percentage of total changes in knowledge score was 29.0% (SD=16.4) and 27.2% (SD=19.2) in the intervention and control groups, respectively. The results of the Mann-Whitney U test showed that the difference in the mean rank of these percentages is not statistically significant (Z value= -0.987, $p$=0.324). Analysis of covariance demonstrated no between-group difference in the changes of knowledge score even after statistical adjustment for the baseline difference in the age of attendees (ANCOVA: F value=1.41, *p*=0.236)” [Nesterowicz K., Fereshtehnejad S. M., Edelbring S., 2015].

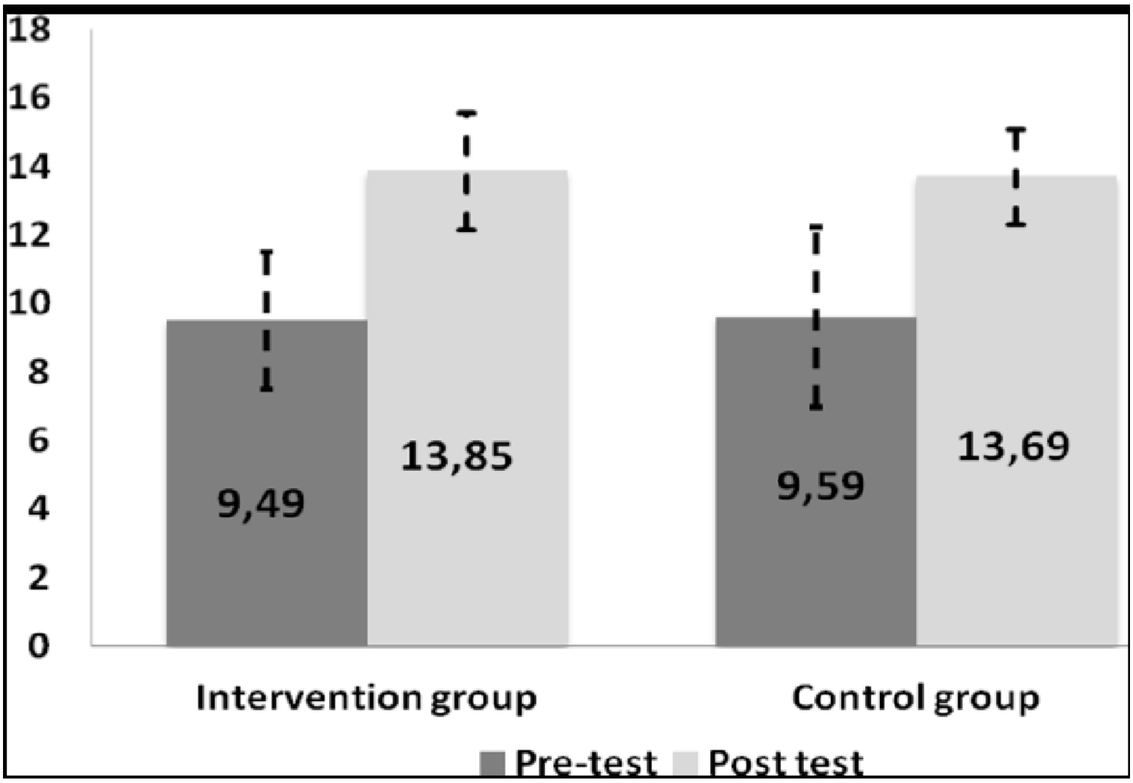



Figure 56. The average results of the pre- and post-test in each study group (intervention group, n=541, control group, n=196, the dotted lines present the 95% confidence intervals visually) [Nesterowicz K., Fereshtehnejad S. M., Edelbring S., 2015].

### 5.2.3. Conclusions

The findings show that e-learning in continuing education may be just as successful as on-site learning in conveying knowledge. Younger pharmacists were also found to take part in e-learning courses more often.

Based on these findings, e-learning can be considered a feasible alternative to on-site continuing education.

## 5.3. Conveyance of Knowledge – Second Study

#### Aims of the study

The goal of this study was to see if e-courses might be a feasible method of providing pharmacy continuing education. The objective was to look at pharmacists' knowledge improvement and user acceptance throughout the introduction of e-learning in continuing education. To lead the study, two research questions were posed: **does e-learning contribute to increasing the knowledge of pharmacists and do today's pharmacists accept e-learning as a medium for continuing education?**

To justify the use of e-learning in continuing pharmacy education, this study analyses empirical data to report on e-learning acceptance and knowledge increase.

### 5.3.1. Methods

For the study on continuing pharmacy education (CPE), two e-learning courses were employed. A scientific committee comprising three pharmacy professors evaluated the content of both e-courses [Nesterowicz K. *et al*., 2011]. The first course, which lasted five and a half months, addressed current antibiotics and chemotherapy for infectious diseases. The other was a one-month trial that looked at the efficacy and safety of new types of anti-diabetic medicines. Attendees who finished the first course, "Modern Antibiotic and Chemotherapy of Infectious Diseases", and passed the final knowledge exam received 10 educational "hard" credits. After completing the final test, users of the second course, "Diabetes as a Problem of Modern Medicine – Effectiveness and Safety of New Classes of Anti-Diabetic Drugs", received 8 educational "hard" credits. Correct responses on at least 60% of the questions were necessary to pass the final exam for both courses.

The course about modern antibiotics and chemotherapy was divided into 5 thematic modules: 1) "Modern Antibiotic Therapy", 2) "Herpesviruses", 3) "Mycoses", 4) "Dysbacterioses", 5) "Antibiotic Therapy". And the course about diabetes included 7 thematic modules: 1) "The Role of a Pharmacist in Prevention and Treatment of Diabetes", 2) "Regulation of Carbohydrate Metabolism", 3) "Complications of Diabetes", 4) "New Perspectives of Pharmacotherapy of Type 2 Diabetes – Incretin Mimetics and Amylin Analogues", 5) "Identification and Reducing the Risk of Hypoglycaemia", 6) "Diabetes in Pregnancy", 7)

"Diabetes - Epidemiology, Aetiology, Symptoms, Treatment and Risk of Complications" [Nesterowicz K., Fereshtehnejad S. M., Edelbring S., 2015].

The material of the courses was delivered via slides saved in the Adobe Flash file format. Text, several images and graphs were included in the presentation. Participants from both courses were simultaneously invited to the research voluntarily. Pharmacists enrolled on the e-learning platform e-dukacja (about 13,000 users at the time) who were required to collect educational credits according to CPE requirements had access to the e-courses and research. The research included 553 participants from all around Poland, representing individuals who worked in community and hospital pharmacies and pharmaceutical wholesales.

An online forum, which is an interactive feature for each course deployed on the e-learning platform, allowed participants to speak asynchronously with one another and with a teacher. The forum is a place where any user may give comments on the course, start a conversation, or ask questions that other users or a teacher can see and answer. It is also a space to discuss general platform feedback, as well as suggestions and recommendations for new e-courses for pharmacists to use on the platform. Furthermore, each user has an internal inbox where he or she may receive and send messages to tutors.

The research was conducted in 2012 and 2013, respectively, and was approved by the Bioethical Commission of Jagiellonian University, opinion no. KBET/235/B/2010.

**Demographics**

The general demographic characteristics of both cohorts are presented in Table 16.

Table 16. Demographics of both cohorts [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

| e-Course | *Modern Antibiotic - and Chemotherapy of Infectious Diseases* | *Diabetes as a Problem of Modern Medicine - Effectiveness and Safety of New Classes of Antidiabetic Drugs* |
|---|---|---|
| *n* (completing the research) | 315 | 238 |
| Gender distribution, male : female | 68(21.6%) : 247(78.4%) | 57(24%) : 181(76%) |
| Average age in years (age range) | 40.8 (26–79) | 40.5 (26–79) |
| Standard deviation in years | 12.3 | 11.5 |

**Knowledge test**

An online exam of 35 questions was created by a team of specialists and used as both the pre- and post-test to measure the knowledge change of attendees in the course "Modern Antibiotic and Chemotherapy of Infectious Diseases". Each expert produced one e-learning module and multiple-choice questions relevant to the module's topic. In the e-learning course content, all authors made sure not to emphasise the test answers accidentally. There was one correct answer and three distractors in each multiple-choice question. A proper response was worth one point out of a possible 35, while an incorrect answer was worth nothing. After finishing the pre-test, learners did not have access to the right responses. The design of the study is presented in Figure 57.

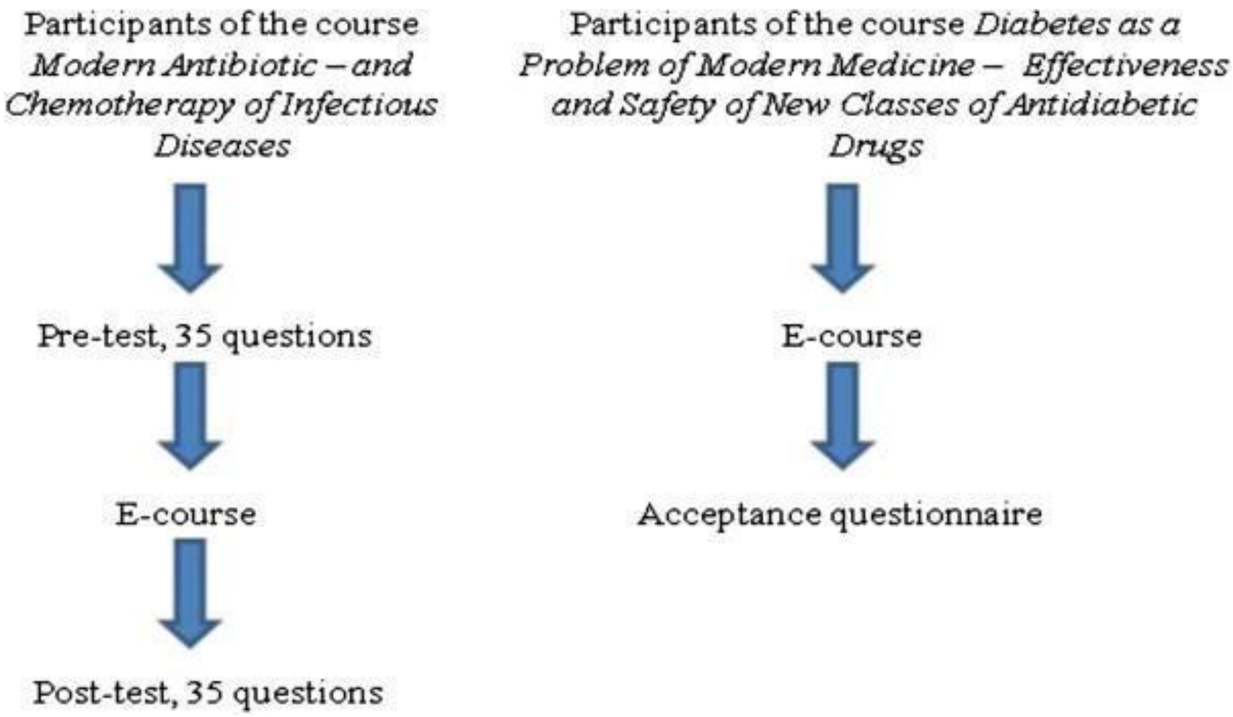



Figure 57. Visual representation of the study [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

There was no intention to discourage e-course participants from seeking out alternative sources of information on the subject covered in e-courses. The questions in the pre- and post-tests were closely connected to the course material, and attendees were allowed to seek out and enhance their knowledge through other media.

**Analysis**

The Wilcoxon signed-rank test was applied to analyse the results of the pre- and post-test knowledge change. Due to the non-normality of the data distribution, this strategy was chosen. In the comparison between the pre- and post-test, a critical value of $p < 0.05$ was used.

## 5.3.2. Results

The e-course "Modern Antibiotic and Chemotherapy of Infectious Diseases" attracted 939 participants. Three hundred fifteen of them completed both the pre- and post-test (participation rate: 34.0%). After taking the e-course, participants' knowledge increased significantly ($p < 0.001$) by 16 pp. Figure 58 shows the average results of the pre- and post-tests as percentages, and Appendix 1 shows the individual results of each participant.

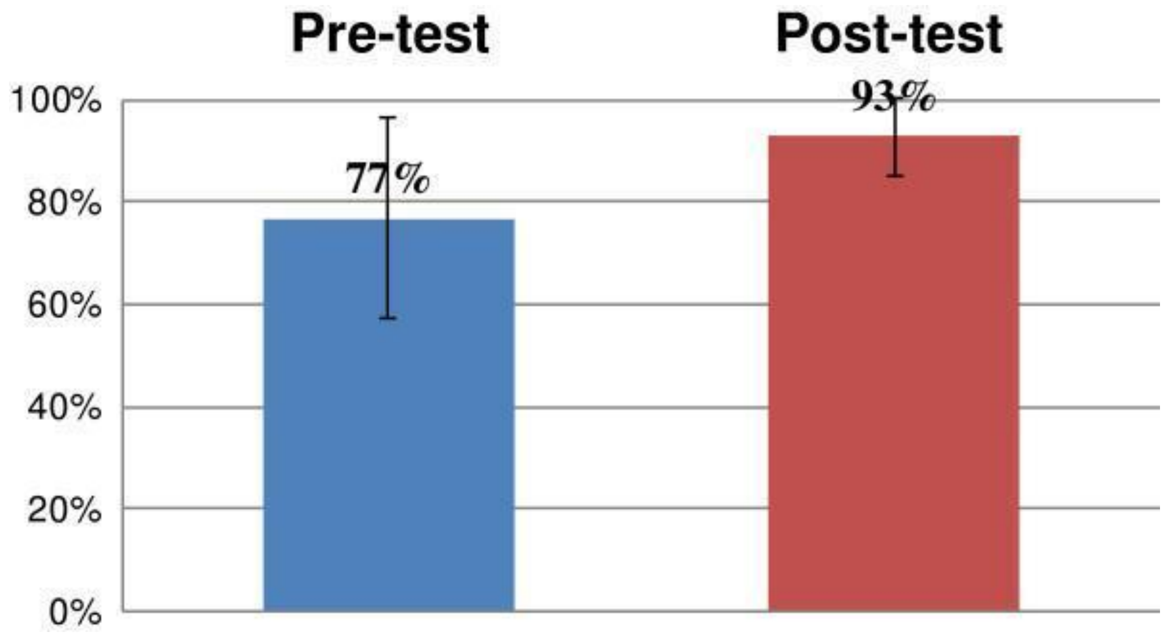



Figure 58. The average results and standard deviation of the test of knowledge conducted before and after the course ($n = 315$, $p < 0.001$) [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

## Chapter Summary

The conveyance of knowledge with the use of e-learning is the topic of the fourth chapter. In the introductory part, there are presented various tools to validate e-learning: knowledge test and questionnaire. Further, two studies are described, designed and conducted to explore the conveyance of knowledge using e-learning courses. The first study compares the knowledge conveyed by e-learning (investigated group) with the on-site course (control group). The knowledge change is assessed by pre- and post-test. The test results show no significant difference in the increase of knowledge between the pharmacists trained by e-learning and those who took part in an on-site course. The second study included 939 participants who attended an e-learning course. They were required to complete the test before and right after the course. Among them, 315 completed both pre- and post-test (participation rate: 34%). The statistical analysis of test results proves a significant increase in knowledge after taking the e-learning course ($p < 0.001$). The knowledge increased significantly by 16 pp.

# 6. EFFICIENCY OF E-LEARNING IN CONVEYING SKILLS

In the following research, I focused on skill transfer using e-learning methods. The research question was raised: **How does e-learning contribute to increasing learners' skills compared to on-site learning?**

The term *skill* is defined as "the ability, coming from one's knowledge, practice, aptitude, etc., to do something well; competent excellence in performance; expertness; dexterity" [Oxford Dictionaries, 2016(b)].

Blood pressure measurement is the foundation for hypertension diagnosis, management, therapy, epidemiology, and research. The accuracy of measurement will impact decisions influencing these aspects of hypertension, for better or worse [O'Brien E. et al., 2005].

**The Aim of the Study**

Blood pressure is a variable haemodynamic phenomenon that is influenced by several elements, such as measuring conditions, temperature, exercise, emotion, meals, cigarettes, alcohol, bladder distension, respiration and pain; blood pressure is also impacted by age, race, and diurnal variation, with blood pressure, typically being lowest during sleep. Although we cannot always change these factors, we may reduce their impact by considering them when evaluating whether a specific blood pressure measurement is relevant [O'Brien E. et al., 1997]. **One needs to obtain special skills to measure blood pressure correctly.**

The goal of the study was to assess the effectiveness of an e-course against a stationary course for pharmacists in terms of skill transfer for proper blood pressure measurement using a mechanical sphygmomanometer with an aneroid manometer and a stethoscope (Figure 59).

Figure 59. Mechanical sphygmomanometer with aneroid manometer and stethoscope [CAL MEDI, 2021].

## 6.1. Methods

The course “Right Monitoring of Blood Pressure for Pharmacists” was offered as an e-learning course for pharmacy students and pharmacists in the study group, as well as an on-site course for participants in the control group.

Participation in the study was voluntary, and the individuals were assigned to one of two groups at random. Access to the study group was open for learners registered on the e-learning platform VBoard. In February 2009, on-site and e-learning courses were held. A physician taught participants in the control group how to measure blood pressure. A presentation and an 8 minutes long educational video were created for participants from the study and control groups. The preliminary exam needed to be passed by participants from both groups. The exam consisted of 10 questions, and to be included in the course and study, one had to answer correctly on at least 6 of them [VBoard, 2015].

The study group comprised 5 pharmacy students and pharmacists, whereas the control group included 6 pharmacy students and pharmacists who finished the course and measurements. The study group had 4 women out of 5 in attendance (80%), whereas the control group had 3 women out of 6 participants (50%).

The content of both courses was the same; the difference was in the communication medium. Each participant who had completed the training worked with one patient who came every Tuesday and Thursday for four weeks to have his or her blood pressure checked. Each measurement was taken twice in one meeting. The difference between the systolic pressure values obtained from two measurements taken one after the other could not exceed 5 mmHg; otherwise, the measurement had to be repeated until the difference between the two was less than or equal to 5 mmHg. The diastolic pressure was preserved under the same conditions (Figure 60). This allowed me to compare the accuracy of the measurements taken by the two sets of assistants. The results of the measurements were recorded in a form.

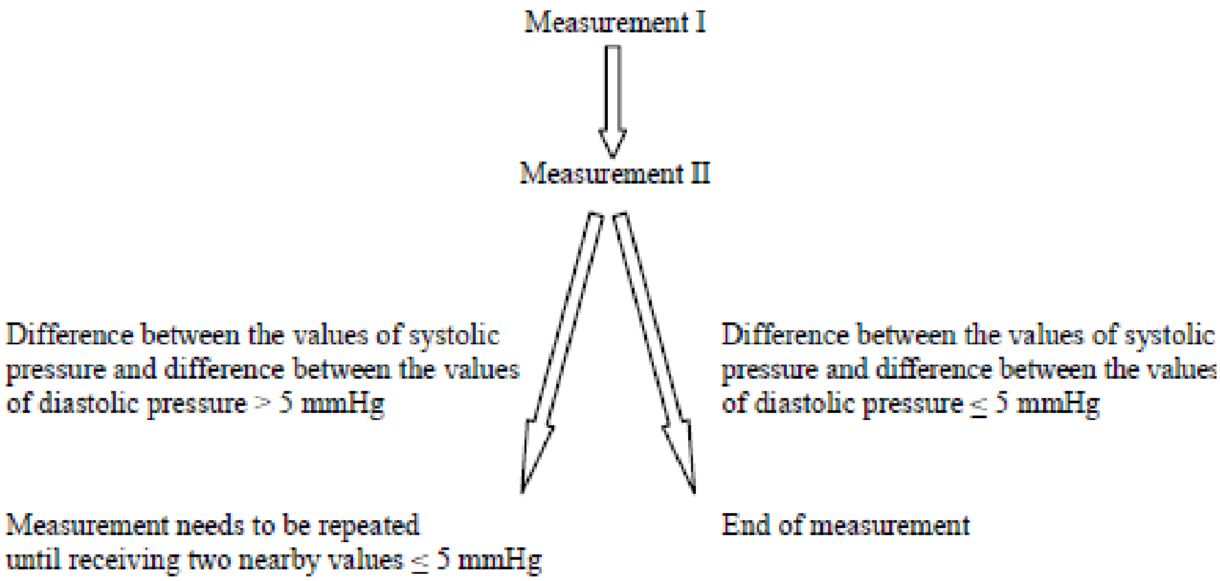



Figure 60. The procedure of the proper measurement of blood pressure [Nesterowicz K., 2012].

All study participants should have adhered to the European Hypertension Association recommendations on clinical, outpatient, and autologous blood pressure measurement, as described below [O'Brien E. et al., 2005]:

*Attitude of observer*

The observer should be in a comfortable position before obtaining a blood pressure reading. The procedure should not be rushed; otherwise, the cuff may deflate too quickly, leading to an underestimating the systolic blood pressure and overestimating the diastolic blood pressure.

*Attitude of patient*

Patients should be asked to relax and advised not to chat to each other for a few minutes before and during the blood pressure measurement.

*The posture of the subject*

The individual should be seated with back support, legs uncrossed, and their arm supported at heart level while measuring blood pressure.

*The cuff and bladder*

If a blood pressure measurement equipment relies on arm cuff occlusion, it will be susceptible to inaccuracy caused by miscuffing, which occurs when a cuff's bladder is too short or too long in relation to the arm circumference (Table 17). The literature review "on the century-old controversy relating to the error that may be introduced to blood pressure measurement by using a cuff with a bladder of inappropriate dimensions for the arm for which it is intended has shown that miscuffing is a serious source of error" [O'Brien E., 1996].

Table 17. Recommended bladder dimensions for adults [O'Brien E., 1996].

| | |
|---|---|
| British Hypertension Society | |
| Standard cuff | Bladder 12 × 26 cm for the majority of adult arms |
| Large cuff | Bladder 12 × 40 cm for obese arms |
| Small cuff | Bladder 12 × 18 cm for lean adult arms and children |
| American Heart Association | |
| Small adult cuff | Bladder 10 × 24 cm for arm circumference 22–26 cm |
| Adult cuff | Bladder 13 × 30 cm for arm circumference 27–34 cm |
| Large adult cuff | Bladder 16 × 38 cm for arm circumference 35–44 cm |
| Adult thigh cuff | Bladder 20 × 42 cm for arm circumference 45–52 cm |

*Observer error*

Systematic error, terminal digit preference or observer prejudice or bias can all contribute to observer error, which can affect measurement accuracy.

*Aneroid sphygmomanometers*

Aneroid manometers are sometimes unreliable. This device's common characteristics include an inflation/deflation mechanism, a cuff-occluded bladder, and the use of a stethoscope for auscultation, all of which can lead to errors. Rheumatoid sphygmomanometers utilise a bellows and lever mechanism to measure pressure, which can become faulty with time and cause misleading low readings.

Performing auscultatory measurement [O'Brien E., 2005]:

- the observer should ensure that the manometer is no more than 1 metre away from the arm so that the scale can be seen readable, that the bladder measurements are precise, and that the bladder's centre is above the brachial artery if the bladder does not entirely encircle the arm,

- the stethoscope should be gently put over the brachial artery at its most pulsating point; the cuff should then be rapidly inflated to about 30 mmHg above the palpated systolic pressure and deflated at a rate of 2–3 mmHg per second,
- the initial signs of systolic blood pressure are faint, repetitive, clear tapping sounds that progressively grow in intensity,
- when noises continue down to zero, muffling of sounds (phase IV) should be recorded for diastolic pressure; when sounds persist down to zero, diastolic pressure should be recorded at the moment of disappearance of sounds or the first mmHg value at which the sounds are no longer audible (phase V).

## 6.2. Results

Eleven pharmacy students and pharmacists from both groups passed the preliminary online test on the platform VBoard [VBoard, 2015], participated in the course, and finished the measurement phase.

Intervention group

Each of the 5 pharmacy students and pharmacists measured blood pressure for his or her assigned patient according to the guidelines provided throughout the training. The measurement needed to be repeated 6 times in the group because the nearby values of systolic pressure or nearby values of diastolic pressure were higher than 5 mmHg.

Control group

The settings were identical to those in the study group. There were 6 pharmacy students and pharmacists. Because of a discrepancy of more than 5 mmHg between neighbouring systolic or diastolic pressure values, the measurement had to be performed 7 times.

Altogether, in both groups, 233 measurements took place over 4 weeks. The difference in measurement precision between both groups was analysed by the t-Student test [O'Connor J.

et al., 2012]. The computer programme Statistica created by Statsoft© was used to analyse results [Statsoft©, 2012].

The obtained p-value was 0.9376, and it was higher than the chosen statistical significance level of 0.05. Based on selected probes and chosen statistical significance level, **the difference in the measurement precision between both groups was not observed**.

## 6.3. Conclusions

Between the study and control groups, there was no statistically significant difference in blood pressure measurement precision. The goal of both courses was to convey and test skills relevant to using auscultatory equipment to measure blood pressure correctly. **Participants in both the e-learning and the stationary courses demonstrated the same preparedness level when assessing their patients' blood pressure.**

### Chapter Summary

This chapter describes the study I designed and conducted to explore how e-learning can be efficient in conveying skills compared to on-site learning. The designed course was about measuring blood pressure for pharmacists. The investigated group consisted of pharmacists trained by e-learning mode and the control one trained by on-site learning. After the training, participants of both types of courses showed the same level of precision in measuring their patients' blood pressure, which was proved statistically with the t-Student test.

# 7. ACCEPTANCE OF E-LEARNING

The word *acceptance* is defined as “the act of taking or receiving something offered; favourable reception; approval; favour; the act of assenting or believing” [Oxford Dictionaries, 2016(c)].

## 7.1. Acceptance of e-Learning – First Study

In the described below study, I focused on users’ acceptance of e-learning. The research question was posed: **What is the users’ acceptance of e-learning compared to campus-based learning?**

### 7.1.1. Methods

**Questionnaire on Acceptance**

A questionnaire comprising four Likert scale items ranging from 1 to 5 and free-text response questions was created to measure users’ acceptance of e-learning (Appendix 2). It covered various topics related to the acceptance of e-learning in continuing pharmacy education (CPE) and its prior use. Attendees could contribute any additional comments in their free-text answers. Only those who completed the e-course “Diabetes as a Problem of Modern Medicine – Effectiveness and Safety of New Classes of Antidiabetic Drugs” were given the acceptance questionnaire.

**Analysis**

Descriptive statistics were used to analyse acceptance questionnaire results. Content analysis was used to study free-text answers and categorise them. The statistical measurement was carried out with the help of the SPSS programme.

### 7.1.2. Results

The e-course “Diabetes as a Problem of Modern Medicine – Effectiveness and Safety of New Classes of Antidiabetic Drugs” was completed by 497 pharmacists. The acceptance questionnaire was completed by 238 people (response rate: 48%). Ninety-four per cent (222 of 237) of respondents had previously participated in e-courses related to continuing pharmacy education (CPE), and 97% (224 of 232) had previously attended campus-based CPE courses. In terms of user acceptance, the course was received well by 91% of survey respondents (217 out of 238) (Figure 61).

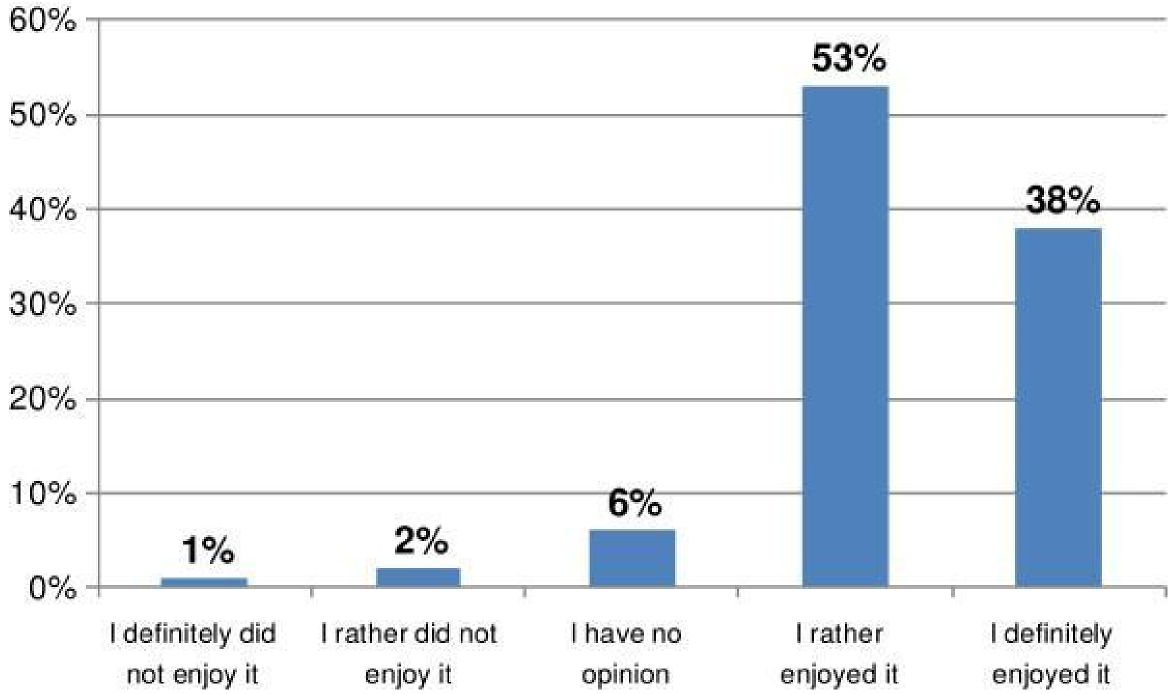



Figure 61. Responses to the question: Did you enjoy the course? (n = 238) [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

Ninety-two per cent of respondents (217 of 236) of the survey thought that e-courses were effective (Figure 62).

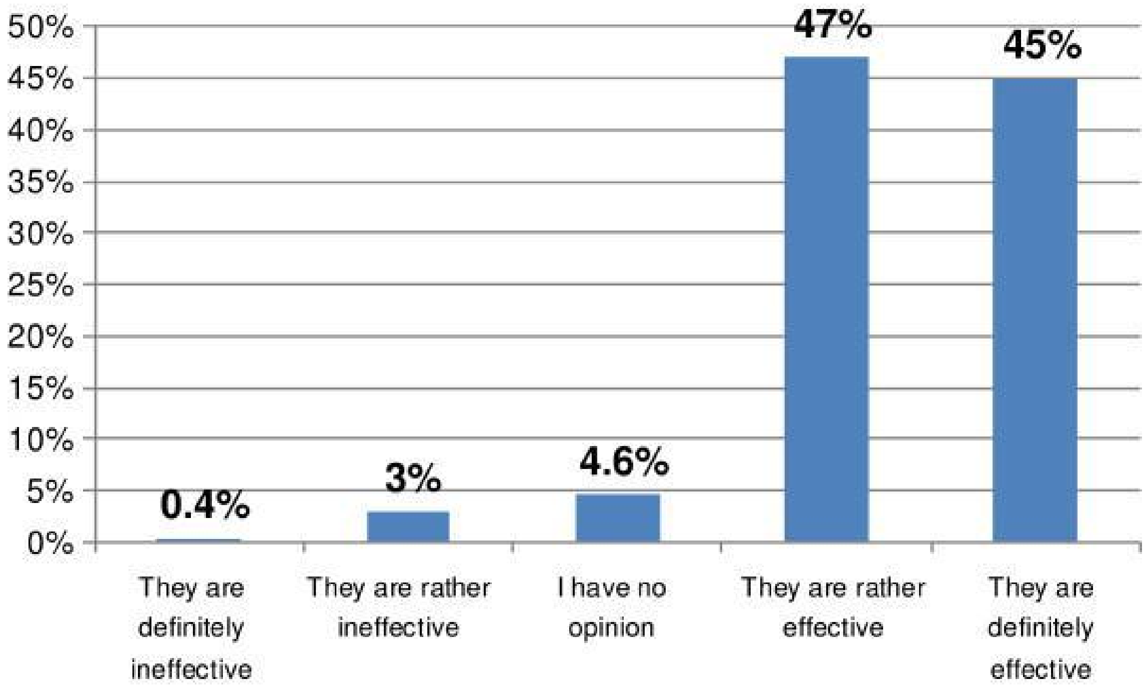



Figure 62. Responses to the question: Please, indicate what you think about the effectiveness of such courses (n = 236) [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

The most valued aspect was the subject of the course (Figure 63).

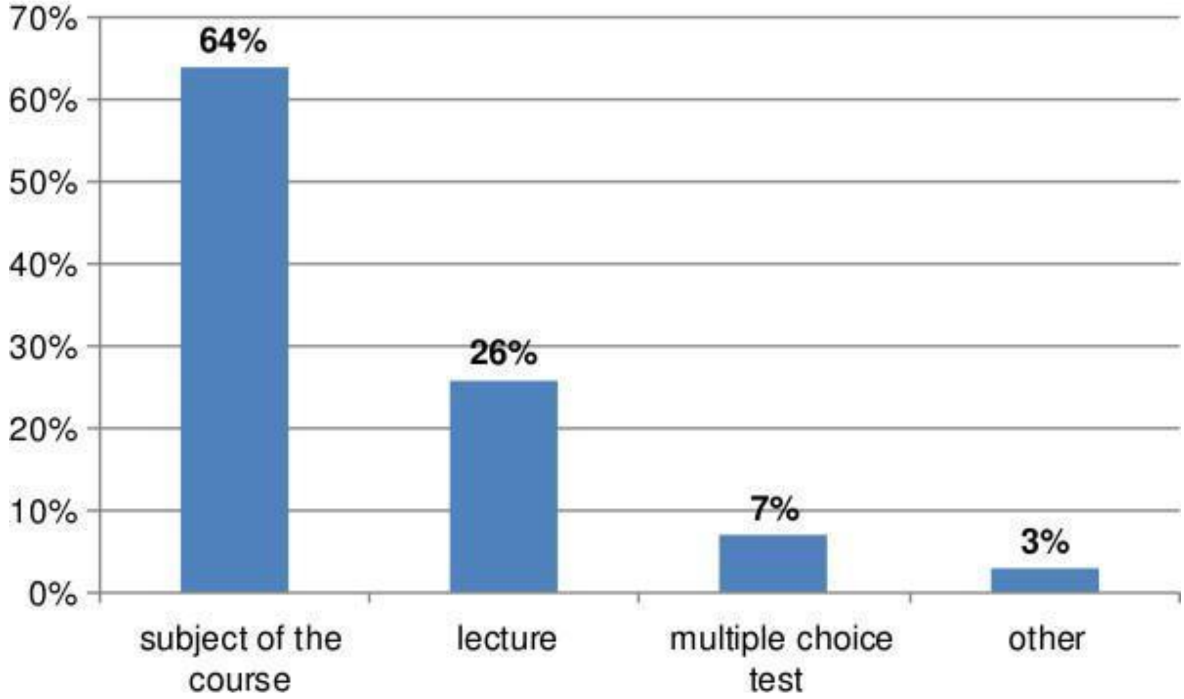



Figure 63. Responses to the question: What did you like the most in the completed course? (n = 235) [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

Open questions requiring written responses (6) identified areas where the course may be improved and demonstrated that participants thought it was a handy way to stay up to date on current pharmaceutical practices.

The least valued element of the course, according to participants, was the form of assessing the knowledge (multiple-choice test – Figure 64).

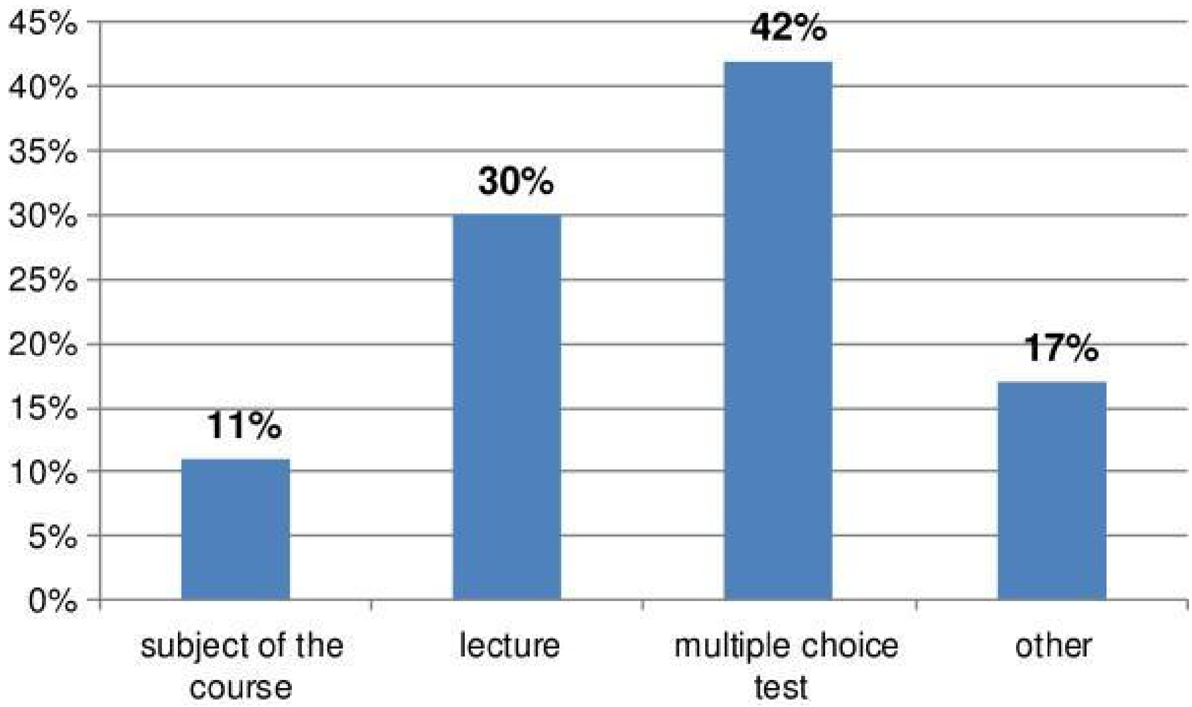



Figure 64. Responses to the question: What did you like the least in the completed course? (n = 201) [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

Five attendees raised the problem of too much material supplied with the course in their free-text replies. Similarly, 5 additional pharmacists raised the issue of the information being too detailed. However, 5 participants said they were pleased with the course.

### 7.1.3. Conclusions

According to the findings, e-learning is a feasible medium for providing continuing pharmacy education. e-Courses are successful in increasing knowledge and are widely accepted by pharmacists working in a variety of settings, including community and hospital pharmacies, pharmacy faculties, and wholesales. Given the growing use of e-learning in continuing pharmacy education, more research is needed to investigate its efficacy in transferring knowledge and its impact on pharmacy practice.

## 7.2. Acceptance of e-Learning – Second Study

Some studies on the effectiveness of e-learning have found that when well-designed, the courses provide knowledge gains comparable to, and sometimes even better than, on-site learning [Chumley-Jones H. S., Dobbie A., Alford C. L., 2002; Fordis M. *et al*., 2005]. Moreover, evidence of considerable self-reported practice change has been seen in various courses [Aggarwal R. *et al*., 2011].

**The long time to prepare lectures, students' feeling of isolation from the tutor, screen fatigue, computer failure, and the inability to provide fast responses to questions that emerge while students are viewing lectures are all downsides of e-learning** [Freeman M. K., Schrimsher R. H., Kendrach M. G., 2006]. Learners can recall knowledge better if all of their senses are engaged: sight, hearing, touch, and smell [Lieb S., 1991]. With e-learning, this is not workable.

A lack of computer skills combined with a lack of engagement with an instructor might lead to liminality, as defined by Land and Meyer - the feeling of unease one gets when one does not completely comprehend the rules or the context of a new situation [Taylor D. C., Hamdy H., 2013].

## The aim of the study related to users' acceptance of e-learning

This study aimed to look at the popularity of e-learning among pharmacists and to figure out why it might not be a widely recognised method of education. I also wanted to explore if younger individuals use e-learning solutions more frequently in their continuing pharmacy education (CPE) than their older colleagues, and if there is a link between e-learning users and the population size of their home areas (village, town, city). Four research questions guided the study: **How does e-learning contribute to continuing pharmacy education? What are the reasons for not participating in continuing pharmacy education using e-learning? Is there a correlation between learners' age and usage of e-learning? Is there a correlation between the usage of e-learning and the size of users' place of residence (village, town or city)?**

### 7.2.1. Methods

The research took place from April 1st to November 30th, 2013. For pharmacists who attended CPE courses, a paper survey was created (Appendix 3). It was delivered to community pharmacists in Krakow and Brzesko, Poland.

In the first question of the survey, I collected demographic information such as gender, age and membership in the regional pharmaceutical chamber. In the second question, I inquired about the size of the questioned person's place of residence. In the third inquiry, I asked about attendance in e-learning courses for continuing pharmacy education. Respondents who replied "No" to the third question were asked why they did not attend such courses in the fourth question.

The Bioethical Commission approved the study of Jagiellonian University, opinion no. KBET/235/B/2010 [Bioethical Commission of the Jagiellonian University, 2013].

**Statistical analysis**

SPSS software v.17 was used to analyse data. The standard deviation (SD), mean, median and interquartile range (IQR) were used to describe numeric variables, while relative frequency percentages were provided for categorical variables. For continuous variables, the normality of distribution was confirmed using the Kolmogorov-Smirnov test. The Mann-Whitney U test was used to compare the mean rank of non-normally distributed continuous variables between males and females. Furthermore, the Pearson Chi-square test was used to analyse the prevalence rate of attendance or reasons for non-participation amongst different study subgroups based on participants' sex, age group and place of residence. A two-tailed *p*-value of less than 0.05 was considered indicating a statistically significant difference in all analytical procedures.

### 7.2.2. Results

A total of 113 pharmacists took part in the poll. Appendix 4 contains the replies that were gathered. There were 92 (81.4%) women and 21 (18.6%) men in the study, with an average age of 33.6 (SD = 9.6) years and 34.1 (SD = 11.5) years, respectively. The Mann-Whitney U test revealed that there was no statistically significant difference in mean age between males and females (p = 0.954). Over half of the participants (n = 61.54%) resided in big cities with more than 100,000 population, whereas 16 (14.2%), 24 (21.2%), and 12 (10.6%) pharmacists were recruited from smaller towns with 30,000-100,000, 10,000-30,000, and fewer than 10,000 inhabitants, respectively.

"Seventy-five (66.4%) pharmacists had taken part in at least one e-learning course in continuing pharmacy education in Poland, while the other 38 (33.6%) had not. The result from the Pearson Chi-square test showed no significant difference in the rate of participation between the male (66.7%) and female (66.3%) pharmacists (Chi value=0.001, $p$ = 0.975). As shown in Figure 65, those pharmacists who had not participated in e-learning courses in continuing pharmacy education were generally older [median = 32 (IQR = 25) years vs median = 30 (IQR = 6) years]. The result of the Chi-square test showed that the participation rate for e-learning courses was significantly higher amongst pharmacists ≤35 years (73.2%) compared to those >35 years of age (48.4%) (Chi value = 6.19, $p$ = 0.013). Moreover, the highest participation rate in e-learning courses was found in the subgroup of pharmacists living in regions with 10,000-30,000 inhabitants. In contrast, the lowest rate was observed in pharmacists residing in small cities with <10,000 residents (Figure 66). The Chi-square test results showed no statistically significant difference regarding the participation rate and place of residence (Chi value = 1.35, $p$ = 0.717)" [Nesterowicz K. *et al.*, 2016].

The most prevalent hurdle mentioned by individuals who had not engaged in continuing pharmacy education via e-learning was "preference to have direct contact with the tutors" for continuing pharmacy education, reported in 60.5% (23 out of 38) of cases. Subgroup analysis showed that "preference to have direct contact with the tutors" remained the most frequent reason for both males and females (Figure 67) and in those ≤35 years or >35 years of age (Figure 68). There was no significant difference in the prevalence of different causes for non-participation in e-learning courses based on the gender (Chi value = 1.79, p = 0.618) or age group (Chi value = 2.15, p = 0.542). As shown in Figure 69, respondents living in big cities had the lowest frequency of "limited access to the Internet" (4.5%); nevertheless, the Chi-square test revealed that these differences were not statistically significant (Chi value = 11.87, p = 0.221).

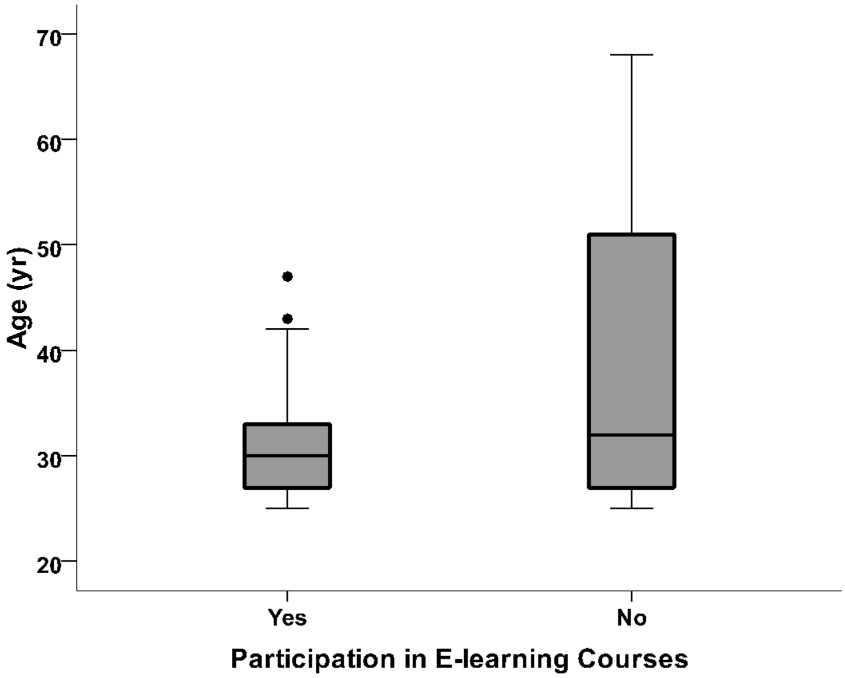



Figure 65. Box plot of the age of the subgroup of pharmacists who had or had not participated in e-learning courses for continuing pharmacy education in Poland [Nesterowicz K. *et al.*, 2016].

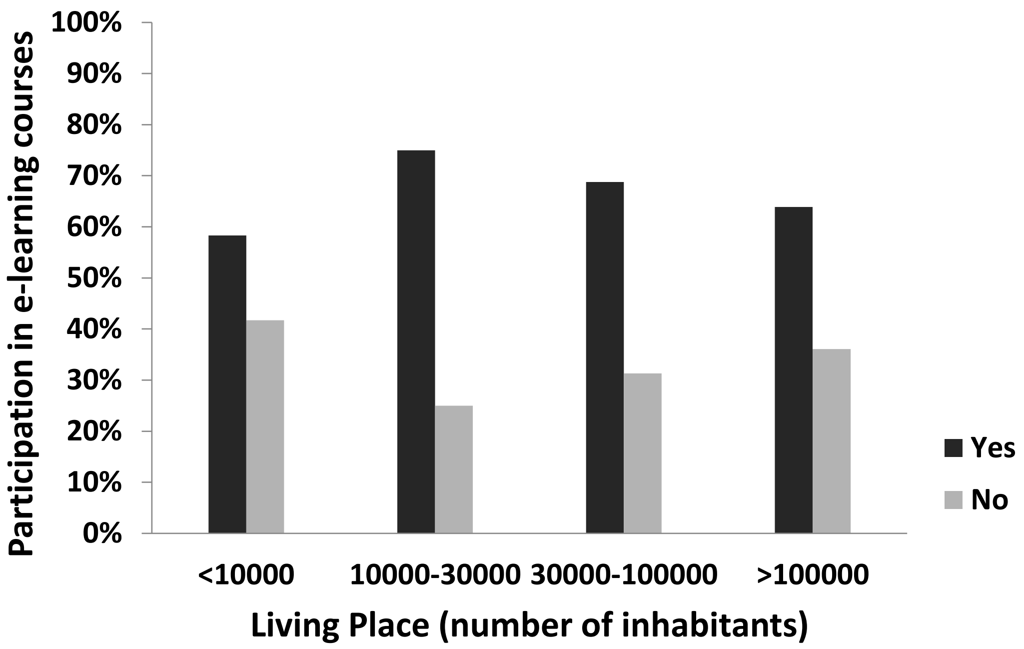



Figure 66. Pharmacists' participation rate in e-learning courses for continuing pharmacy education in Poland within different living places regarding population size [Nesterowicz K. et al., 2016].

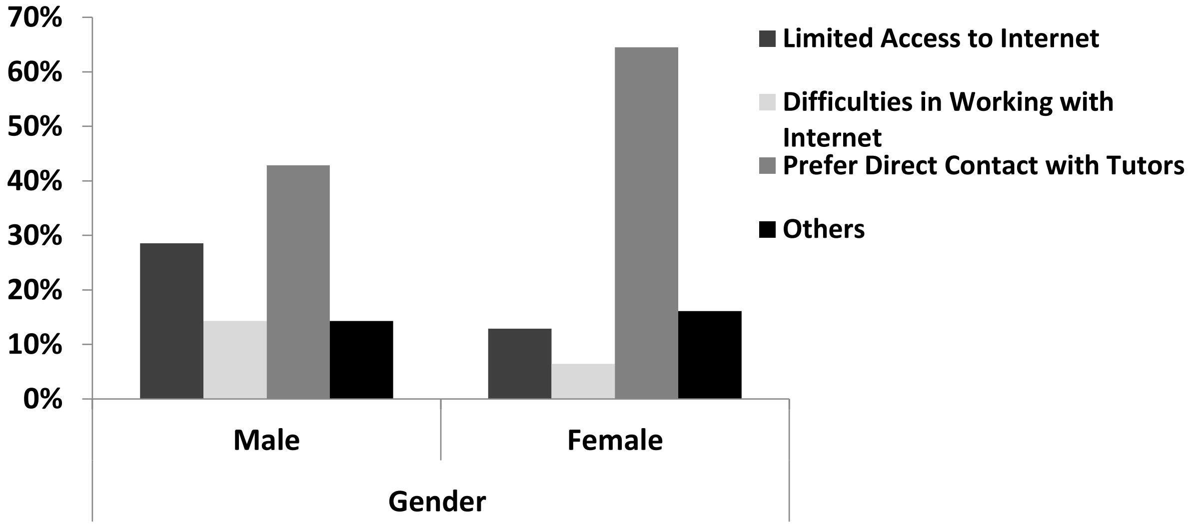



Figure 67. Main reasons for non-participation in e-learning courses for continuing pharmacy education by male and female Polish pharmacists [Nesterowicz K. et al., 2016].

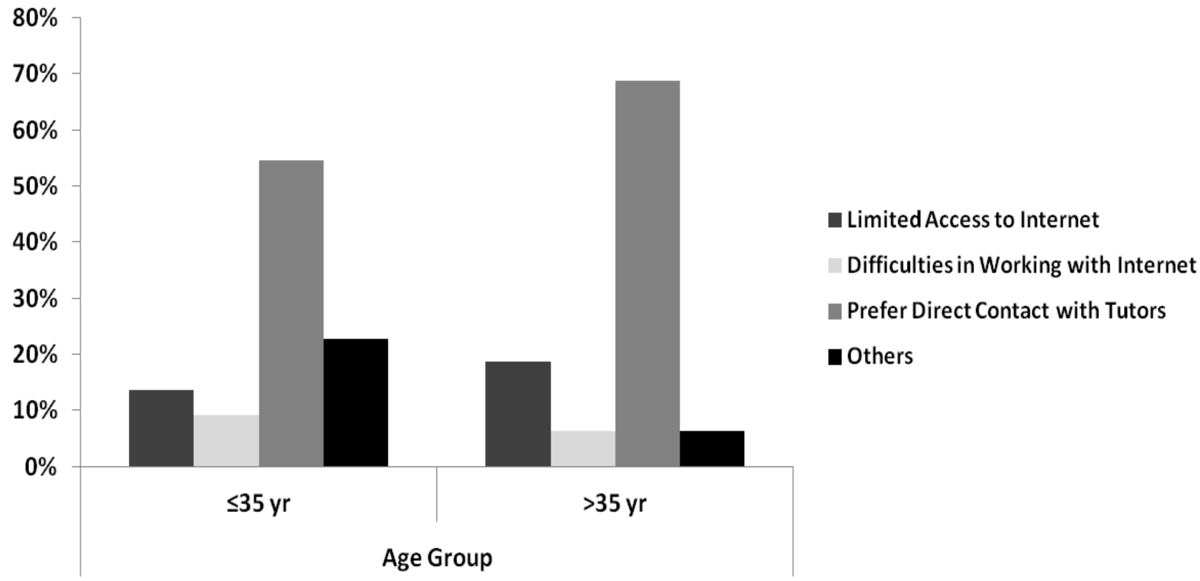



Figure 68. Main reasons for non-participation in e-learning courses for continuing pharmacy education in Polish pharmacists aged ≤35 years or >35 years [Nesterowicz K. et al., 2016].

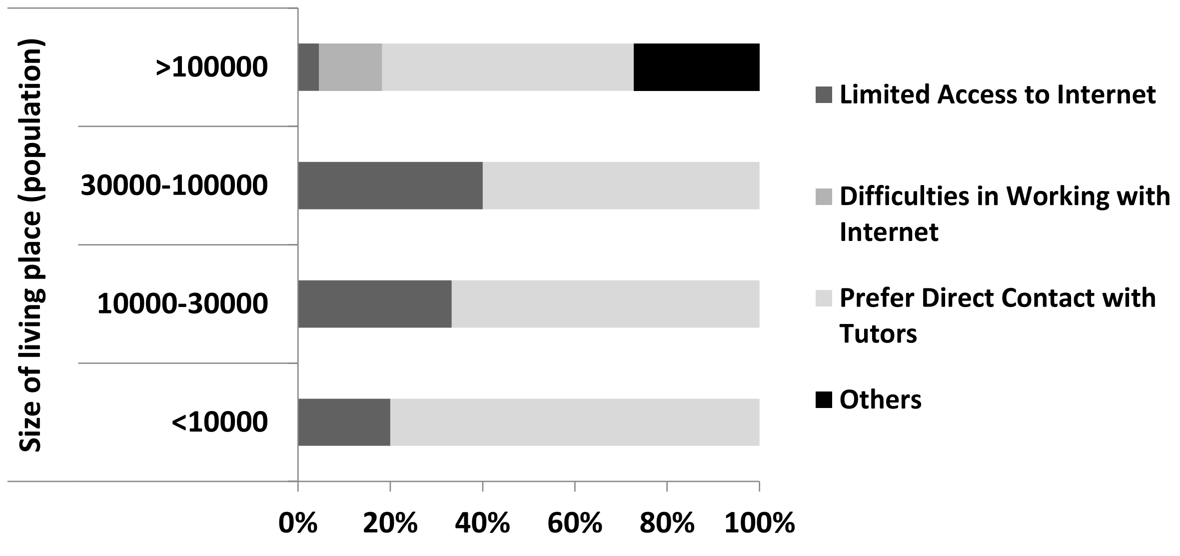



Figure 69. Main reasons for non-participation in e-learning courses for continuing pharmacy education in Poland regarding different living places [Nesterowicz K. et al., 2016].

### 7.2.3. Conclusions

Nowadays, most pharmacists prefer to participate in e-learning continuing education courses in Poland.

Most of the users of online courses are younger pharmacists with an equal proportion of males and females participating.

From the results obtained, it can be concluded that a major reason for the non-attendance in e-learning courses was the **lack of face-to-face contact with a tutor.**

## Chapter Summary

I present two studies focused on the acceptance of e-learning in continuing education among learners. I prepared the questionnaire for both cases to check the level of satisfaction with using e-learning and the reasons for non-participating in this mode of instruction.

In the first study, I compare the level of satisfaction of pharmacists about using e-learning to on-site learning. The posed research question is: What is the users' acceptance of e-learning compared to campus-based education?

The questions posed for the second study are: "How does e-learning contribute to continuing pharmacy education? What are the reasons for not participating in continuing pharmacy education using e-learning? Is there a correlation between learners' age and usage of e-learning? Is there a correlation between the usage of e-learning and the size of users' place of residence (village, town or city)?" [Nesterowicz K. et al., 2016].

The study shows that pharmacists highly accept e-learning from diverse working environments, such as community and hospital pharmacies, faculties of pharmacy or wholesales. "The main reason for non-participation in e-learning courses is the **lack of face-to-face contact with a tutor**" **[**Nesterowicz K. et al., 2016**].**

# 8. DISCUSSION

Stakeholders and scholars have frequently posed the topic: “Do computers improve learning?” Even if earlier media breakthroughs (e.g., cinema, radio, and television) had continuously failed to have the intended effect, hopes were high in the 1970s and 1980s that computers alone would favourably affect learning [Cuban L., 1986]. The computer generation of media comparison studies were all experimental or quasi-experimental, and they looked to see if one delivery medium (computer) was preferred over another (book or worksheet). In a typical media comparison research, all other variables were controlled to establish that teaching given through computers was more effective than training delivered through traditional methods (for a summary, see [Clark R. E., 1983]). To prove causality, all other instructional noise, such as educational strategies and methods, had to be kept constant; thus, when well designed, these studies allowed researchers to respond to the question “Does it work?” where the computer was simply the computer and the work was the performance on a post-test or some other learning outcome. The value of this line of inquiry was questioned by several researchers, most notably Clark in his work - “Reconsidering Research on Learning from Media”. Efforts to elevate the importance of any media in learning, according to Clark, should be abandoned entirely. “Many of the studies attributing learning gains to media either had unexplored alternative explanations or unintentionally attributed the impact of instructional methods to the delivery medium, with methods defined as the conditions that can be implemented to foster the acquisition of competence” [Glaser R., 1976, p. 1, as cited in Clark R. E., 1983].

**Product utility, cost-effectiveness**, and **learner satisfaction** are three elements of e-learning that have been systematically investigated [Ruiz J. G., Mintzer M. J., Leipzig R. M., 2006]. The widespread belief that modern communication and information technologies are considerably closer to education than their non-digital forerunners may lead to more seamless implementation in education. According to computer use surveys, just a tiny percentage of computer time is spent learning. Learning and knowledge building, in contrast to the simple practice of discovering useful material on the Internet, are developmental processes that integrate new knowledge with prior knowledge and guide to enhanced abstraction, understanding, and conceptual transformation. Learning is a process that takes time and requires mental work, motivation, and cognitive capacity. **Learning is defined “not by the**

**quantity of information available but by the gradual transformation of relevant information into knowledge”** [Lowyck J., 2008].

Technology’s role in education and training has long been criticised. Cuban demonstrated how technology has traditionally had little influence on educational advancements, using television and radio as examples of failures [Cuban L., 1986; Cuban L., 2001]. Many educators in the 1980s were concerned about the lack of social contact in technology-aided learning experiences [Hawkins S. *et al*., 1982; Baker C., 1985; Cuban L., 1986; Isenberg R., 1992]. Clark argued that “**it is the pedagogy underlying a learning environment, rather than the technology per se, that typically explains learning gains”** [Clark R. E., 1983].

Although educational technology research is frequently aligned with advancements in the field, it began with several studies at a microlevel of complexity: evaluation of the effectiveness and efficiency of computer software, identification of minimal conditions for implementing technology in schools, insight into the main characteristics of learners exposed to technology, and so on. The increasing complexity and breadth of technology use in education necessitate new research methods [Lowyck J., 2008].

Lashley and Watson’s study on the use of World War I military training videos to prevent venereal disease with civilian audiences [Lashley K. S., Watson J. B., 1922] was the first official research on educational uses of media. The Chronicles of America Photoplays, created by Yale University in the late 1920s, were an early large-scale effort to develop and produce a collection of films, particularly for schools. Knowlton and Tilton investigated the use of these historical videos in seventh-grade classes. One of their findings was that the instructional value of such videos was determined not only by the quality of the contents but also by how skilfully teachers utilised them [Knowlton T. C., Tilton J. W., 1929]. **This discovery that the instructional value of any media product is primarily “determined by how it is used would be rediscovered by each succeeding generation with its new media: radio, television, programmed instruction, computer-based instruction, and now Internet-based learning environments”** [Molenda M., 2008].

**“With few exceptions, hundreds of media comparison studies have shown no differences in learning”** [Clark R. E., 1994; Dillon A., Gabbard R., 1998; Ruiz J. G., Mintzer M. J., Leipzig R. M., 2006]. A meta-analysis by Bernard et al. combining research studies that compared learning from “electronic distance education to traditional classroom instruction indicates no practical differences in learning between face-to-face and electronic distance learning” [Bernard R. M. *et al*., 2004]. Figure 70 illustrates the overall distribution of 318 achievement outcomes of electronic distance learning versus on-site learning comparison studies. It is a symmetrical distribution with a near-zero mean (as shown), a standard deviation of ±0.439, a skewness value of 0.203, and a kurtosis value of 0.752; the distribution is nearly normal. It is clear from the range of effect sizes (−1.31 to +1.41) that some distance learning applications are “far better than classroom instruction and that some are far worse” [Bernard R. M. *et al*., 2004].

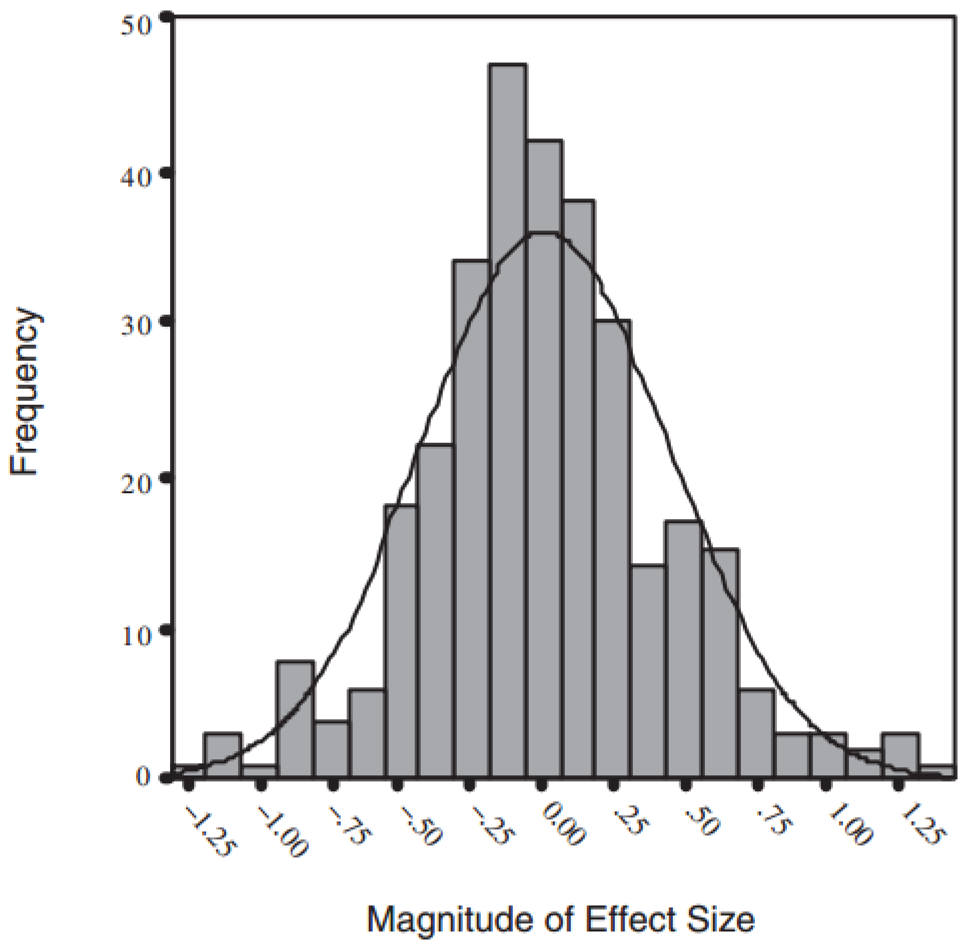



Figure 70. Distribution of 318 achievement effect sizes [Bernard R. M. et al., 2004].

Although ICT is a fundamental condition required for e-learning, Sulčič and Lesjak assert “it has no statistically significant impact on the effectiveness of e-learning” [Sulčič V., Lesjak D., 2009]. Russell found no significant differences between campus-based and online learning

[Russel T. L., 2001]. They concluded that on-site courses should be modified appropriately for e-delivery. Attrition rates reported by different authors range from 70% to 80% [Dagger D., Wade V. P., 2004; Flood J., 2002] to 20% to 50% [Frankola K., 2001; Diaz D. P., 2002]. These attrition rates may be considerably higher than those observed in traditional face-to-face education (10% - 20%) [Carr S., 2000]. Novo-Corti, Varels-Candamio and Ramil-Diaz report an increase in student performance (grades and qualifications) when using a hybrid technology of e-learning in Moodle and face-to-face lectures [Novo-Corti I., Varels-Candamio L., Ramil-Diaz M., 2013].

**According to a large body of data, learning in an online setting may be just as successful as learning in a traditional classroom.** Second, the quality of online training affects students' learning. Students "in well-designed and well-implemented online courses learn more effectively than in online courses where teaching and learning activities are not well planned, and delivery and accessibility are hampered by technical issues" [Clark C. R., Mayer E. R., 2012].

Employees' willingness to take computer-based classes needs to be considered by practitioners. Participants have more positive views about technology-mediated classes, are satisfied with their learning experience, and are ready to use it again after participating in a technology-mediated class "as long as technical difficulties are not overwhelming" [Welsh E. T. *et al*., 2003].

In recent years, there has been an upsurge in research on the effectiveness of e-learning. This is due to increasing IT and learning capabilities and political and organisational attention to understanding what works. Figure 71 depicts the 761 publications that apply to this study. Because the structured search took place in October 2013, fewer publications were published in 2013 than in any other year [Noesgaard S. S., Ørngreen R., 2015].

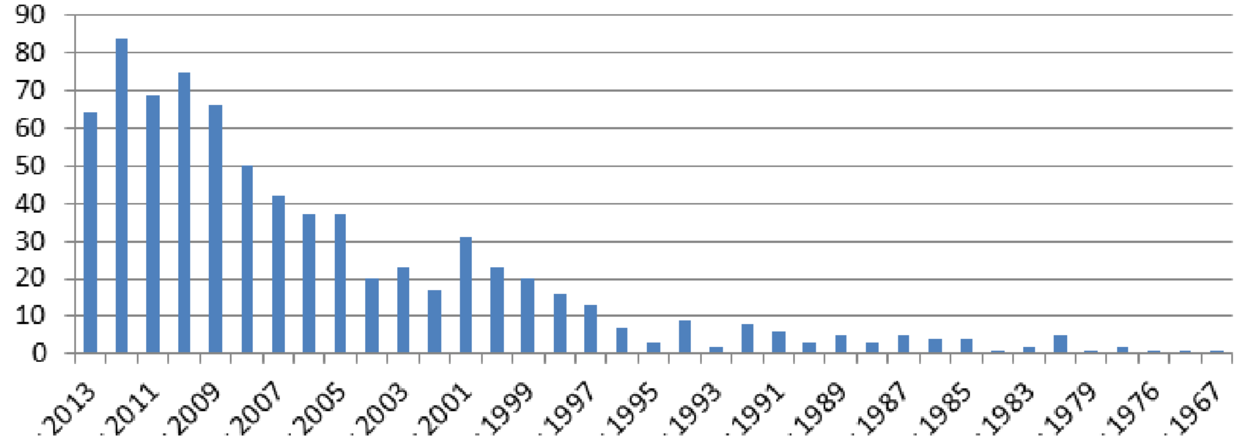



Figure 71. The number of published papers per year [Noesgaard S.S., Ørngreen R., 2015].

One study, for example, focuses on the use of e-learning to transfer skills. Janet C. Craig performed a study at Capella University in 2007 and found that the efficacy of e-learning courses in teaching desired skills was successful [Craig J. C., 2007].

In the second research on conveying knowledge, I found it intriguing and vital that **most of the cohort (92%) said that e-courses were successful** (Figure 62). The course "Diabetes as a Problem of Modern Medicine" was received well by 91% of participants (Figure 61). The pharmacists who answered referred to the value of such CPE courses and mentioned their necessity for them.

"e-Learning systems have become important tools in the continuing education of pharmacists and other healthcare specialists" [Nesterowicz K. *et al.*, 2011]. As seen from the study outcomes, the majority of pharmacists (66.4%) had participated in an e-learning continuing pharmacy education course at least once.

Some literature states that "**e-learning solutions are convenient for people interested in updating their knowledge but live far away from academic centres** or cannot travel easily within the country due to geographical barriers" [Khakurel A., 2007]. Distance learning allows people to be involved in such courses and save time and money that otherwise would be spent on travelling. Learners may obtain knowledge over the Internet in areas where colleges are not accessible, which is a cost-effective option that will improve education, literacy, and economic growth [Aggarwal D., 2009; Anand R., Saxena S., Saxena Sh., 2012]. However, in our intervention group, I did not find a statistically significant correlation between the participation rate in e-learning courses and the size of the place of residence.

There seems to be a need for improving the interaction between trainees and tutors in e-learning [Rohwer A., Young T., van Schalkwyk S., 2013]. The most frequent reason reported by pharmacists in the study who did not take part in e-learning courses was that they preferred face-to-face contact with a tutor. Offering an online module has its own set of obstacles, some of which might be overcome by using new technology to provide a more genuine learning environment [Rohwer A., Young T., van Schalkwyk S., 2013] that makes possible synchronous and asynchronous communication between trainees and their tutors, as well as amongst trainees.

The effectiveness of online learning differs by age group. **According to the standard view, children, especially younger ones, require a controlled environment since they are more easily distracted.** According to Dowson Tong, Senior Executive Vice President of Tencent and President of Tencent Education, a joint effort is required to bring this structure and go beyond replicating a physical class through video capabilities by utilising a range of collaboration tools and engagement techniques that promote “inclusion, personalisation, and intelligence” [Li C., Lalani F., 2020].

**Online education institutions should implement anti-cheating procedures to safeguard the validity of e-learning.** Online proctoring systems (e.g. Examity), which use anti-cheating methods like “automatic ID verification and machine learning to detect fraudulent test-takers, are the most popular” [Tamm S., 2019].

Last but not least, we see **artificial intelligence plays a more prominent role in the e-learning environment** [Neelakandan N., 2019].

# 9. LIMITATIONS AND RECOMMENDATIONS FOR FUTURE STUDIES

Studies of higher education, government, and business contexts have proven mainly the efficacy of e-learning [Gibbons A., Fairweather P., 2000; Bernard R. M. *et al*., 2004]. This research, however, has limitations, particularly in terms of scientific design [Letterie G. S., 2003; Bernard R. M. et al., 2004]. Such studies frequently fail to identify the content quality, technological features, and e-learning intervention under investigation. In addition, most have used various instructional and delivery techniques, making the analysis more difficult [Piemme T. E., 1988]. The majority of this research compared on-site methods to e-learning [Bernard R. M. *et al*., 2004; Johnson C. E. *et al*., 2004].

The second research, which looked at transferring knowledge, did not use a control group and instead utilised a pre- and post-test in a real-life scenario. This means we cannot exclude the potential of additional knowledge gains from other sources. The naturalistic context, on the other hand, adds to greater ecological validity.

Because of the voluntary nature of the pre-test, the completion rate of the pre- and post-test was low (34%). The voluntary acceptance questionnaire was in the same boat. However, the number of people who participated in both experiments was fairly high: 315 for the pre- and post-test and 238 for the acceptance questionnaire. Nonetheless, we cannot rule out the possibility that the participants' representation was skewed due to a lack of data on the differences between respondents and non-respondents. It is realistic to expect that pharmacists who are averse to e-learning will not apply for e-courses. Future research should look at the reasons for non-participation in e-learning.

The research on measuring the effectiveness of e-learning in the conveyance of skills is novel. There are numerous examples of research on continuing education linked to knowledge transfer. Still, only a few studies focus on transmitting skills and subsequently validating those gained by participants in the available literature. As a result, further research is needed in this area, mainly because my study on skills transfer had a small sample size (only 5 participants in the intervention group). Therefore, it was unrepresentative. There is a need to further study on the subject with a more significant number of participants.

The research mentioned above, in my opinion, contributes to information about acceptance and enhanced learning, which is critical for applying innovative educational techniques. According to Kirkpatrick's educational assessment model, the following phases are a change in behaviour and an impact on practice [Kirkpatrick D. L., Kirkpatrick J. D., 2006]. To determine the effectiveness of e-learning in continuing education, future research should attempt to achieve these aspects.

Furthermore, researchers are invited to compare various platforms and course designs. This is the first step towards increasing knowledge and acceptance of e-learning in this user group (pharmacists in continuing education).

It is crucial to note that all pharmacists who participated in the e-course were previously enrolled on the e-learning platform e-duk@cja, and neither group was randomly assigned.

Technology integration in rich learning scenarios is a key research topic for the next five years. There has always been a focus on specific media and technologies in the field of educational communications and technology; however, in future learning scenarios, people, resources, and tools will be connected via wired and wireless networks, as well as formal and informal networks, thanks to the availability of interconnected sets of (mobile) devices. Although there is a lot of discussion about technological integration these days, relatively little actual work is being done. Foremost, we require a comprehensive definition of technology integration that applies to learning and instruction. Given the growing diversity of technology and methods for aiding learning, this will become a severe problem. It is proposed that technology is successfully integrated into learning and instruction when the interest and focus are on what the technology makes possible—the affordances—rather than on the technology itself (e.g. the dialogue itself in a video-based dialogue via the Internet or formulation and testing of a hypothesis in a Web-based interactive simulation). Surprisingly, successful integration is unaffected by the technology involved. In the coming years, technology integration—what it is, what makes it more or less effective, and how and why it contributes to learning—will be a big field of study. Because general problem-solving, reasoning abilities and self-directed learning skills are required to cope with rapid changes in technology and professions, research will growingly focus on techniques and models for complex learning. Indeed, society is increasingly looking for people who can deal with ambiguity and adapt quickly and flexibly to changing work conditions. Such models are aimed towards learning in rich task contexts, gaming environments, social networks, and so on [Kim C. M. *et al*., 2008].

Lifelong learning in professional and informal contexts will become increasingly vital due to fast technology and cultural developments. This presents new challenges to educational communications and technology, which before were concentrated mainly on learning in more or less formal and less dynamic contexts. Unique needs for experienced instructional and performance technologists and focused research in these fields will result from this emphasis on complex and informal learning [Kim C. M. *et al*., 2008].

# 10. MAIN CONCLUSIONS

If e-courses are to be effective tools, they must have the **proper design, knowledge increase, and acceptance**. This is one of the first studies to look into those components of public workers' continuing education. This study is important because it examines how successful e-learning is in increasing knowledge and acceptance of this learning method. There are just a few examples of such research on continuing education in the literature. One experiment was conducted in 2009 and published in 2012, which explores the conveyance of skills with the use of e-learning in continuing pharmacy education (CPE) [Nesterowicz K., 2012]. The study evaluated the effectiveness of an e-learning course to a campus-based one by testing blood pressure measurement using a mechanical sphygmomanometer, an aneroid manometer, and a stethoscope. However, there were no significant variations in blood pressure measurement precision between the intervention (e-learning course) and the control (on-site course) groups. Pharmacists taught through e-learning and campus-based courses demonstrated the same degree of preparedness when assessing their patients' blood pressure. As a result, e-learning can **"convey some skills the same as traditional methods"** [Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

The concept of e-learning has not been completely new for public servants' training. There have been e-learning activities in recent years as well, but they were mostly supplementary to traditional campus-based study. In the new concept introduced by the e-Learning Methodology Centre, there are e-learning courses without any on-site education elements. We need to highlight two main conclusions regarding these efforts, based on the lessons learned from e-learning in public administration. The first lesson is that shifting to modern education and teaching is not about technology. Human factors are much more challenging, so it is essential to deal with the motivation, training, learning habits of the public servants and their attitudes towards education. The principal output of EMC is the learning experience where complex, comprehensive needs and impact assessments are vital for training activities. The second lesson was about innovation impact, which proved to be a tricky thing. In this project, EMC developed IT tools with different methods, and forms in creating new content for e-learning: animated videos, future related adaptive learning, and simulation tools. The question was how far the adoption threshold can be pushed, and the tolerance of newer and newer topics. It has not proven to be satisfactory to see only the learning outcome since one can use tools and forms. Still, the latest innovative tools can be controversial or might be counterproductive as well [Nemeslaki A. *et al*., 2014(a)].

In the E-learning Methodology Centre, "it has been established a creative working environment for four professional groups – leaders, methodology experts, IT developers and curriculum writers – which has ensured that over 100 different types of e-learning materials have been created, tested and published for the Hungarian civil service continuing education" [Orbán Z. *et al*., 2015]. **The multidisciplinary cooperation came out to be successful in producing many high-quality e-learning courses in a proportionally short period.**

The phenomenon of e-learning is dynamic, and it is hard to forecast its accurate place and shape in the lifelong learning process soon. Undoubtedly, e-learning will be more relevant in the future than it is now and play a more significant role in continuing education and the business sector [Poór J. *et al*., 2016].

**The knowledge test administered before and after the courses revealed that both modalities were equally successful.** As a result, it is acceptable to state that e-learning has grown into a suitable medium for conducting pharmacist education, comparable to traditional on-site instruction. Furthermore, **no significant association was detected in either group between participants' age and the degree of change in their knowledge.**

It was up to the participants to choose between e-learning (intervention) and an on-site course (control). Some variations in modality selection preferences were noticed. Although there was no significant difference in e-learning involvement between men and women, there was a tendency toward increased participation in e-learning among males (15% in the e-learning and 11% in the on-site course).

This study is relevant because it evaluates the efficacy of adopting e-learning as a new model of continuing education. The research has a high sample size, making the findings trustworthy and generalisable, which is a significant advantage over many educational interventions.

The study aims to see if e-courses can improve CPE knowledge and if pharmacists embrace the e-course format. Professionals from community and hospital pharmacies and those working in pharmaceutical wholesale represented the population. The "main finding of this study is the **effectiveness in terms of increased knowledge (16%) by using an e-learning course" [**Nesterowicz K., Librowski T., Edelbring S., 2014(a)].

The study's major finding concerning skill conveyance is confirmation of **equal effectiveness in skill transfer via e-learning and stationary techniques**. It was confirmed with an emphasis on the precision of blood pressure measurements in both groups. There were no statistically significant differences between the study and control groups.

**Attendees also expressed high levels of acceptance and satisfaction with e-courses**. Acceptance is indicated directly in the survey results and by a significant number of voluntary attendees. Participants expressed their appreciation for the value of this type of learning in their ongoing education. As a result, it is reasonable to conclude that online learning adds to pharmacists' increased knowledge. In addition, today's pharmacists consider e-learning as a form of continuing education.

**The gender distribution among users of e-learning platforms was likewise found to be unremarkable** in this study. However, **there was a significant age gap: younger people utilise e-learning platforms more often than their older counterparts.**

e-Learning has been adopted and approved as an instructional tool among public servants and pharmacists. The study is important and generalisable since it uses large research samples of both demographics (**over 60,000 public workers** and **over 1,200 pharmacists**).

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## LIST OF FIGURES

# LIST OF TABLES

**APPENDIX 1. Individual results of each participant of the e-course "Modern Antibiotic and Chemotherapy of Infectious Diseases".**

| Pre-test results | Post-test results |
|---|---|
| 80 | 88,57 |
| 97,14 | 100 |
| 97,14 | 100 |
| 85,71 | 88,57 |
| 91,43 | 94,29 |
| 91,43 | 88,57 |
| 37,14 | 91,43 |
| 97,14 | 94,29 |
| 88,57 | 97,14 |
| 71,43 | 88,57 |
| 82,86 | 100 |
| 88,57 | 100 |
| 40 | 91,43 |
| 77,14 | 91,43 |
| 77,14 | 91,43 |
| 2,86 | 97,14 |
| 91,43 | 91,43 |
| 80 | 88,57 |
| 88,57 | 100 |
| 80 | 94,29 |
| 85,71 | 88,57 |
| 88,57 | 94,29 |
| 71,43 | 88,57 |
| 51,43 | 91,43 |
| 71,43 | 97,14 |
| 88,57 | 100 |
| 100 | 100 |
| 97,14 | 97,14 |
| 57,14 | 100 |
| 74,29 | 85,71 |
| 42,86 | 88,57 |
| 82,86 | 97,14 |
| 88,57 | 94,29 |
| 80 | 100 |
| 97,14 | 97,14 |
| 94,29 | 100 |
| 60 | 97,14 |
| 97,14 | 100 |

| Pre-test results | Post-test results |
|---|---|
| 91,43 | 97,14 |
| 65,71 | 74,29 |
| 71,43 | 94,29 |
| 82,86 | 91,43 |
| 71,43 | 88,57 |
| 82,86 | 97,14 |
| 94,29 | 88,57 |
| 60 | 48,57 |
| 85,71 | 88,57 |
| 71,43 | 88,57 |
| 48,57 | 80 |
| 68,57 | 85,71 |
| 45,71 | 94,29 |
| 91,43 | 97,14 |
| 80 | 91,43 |
| 91,43 | 97,14 |
| 80 | 97,14 |
| 88,57 | 100 |
| 57,14 | 100 |
| 62,86 | 88,57 |
| 91,43 | 97,14 |
| 45,71 | 77,14 |
| 100 | 100 |
| 94,29 | 100 |
| 11,43 | 68,57 |
| 91,43 | 100 |
| 82,86 | 100 |
| 48,57 | 100 |
| 68,57 | 85,71 |
| 82,86 | 100 |
| 82,86 | 97,14 |
| 57,14 | 94,29 |
| 68,57 | 94,29 |
| 88,57 | 91,43 |
| 94,29 | 100 |
| 97,14 | 94,29 |
| 65,71 | 97,14 |
| 100 | 100 |
| 40 | 94,29 |
| 97,14 | 97,14 |
| 100 | 100 |
| 100 | 100 |
| 82,86 | 97,14 |
| 71,43 | 94,29 |

| Pre-test results | Post-test results |
|---|---|
| 65,71 | 88,57 |
| 74,29 | 100 |
| 60 | 91,43 |
| 94,29 | 100 |
| 77,14 | 100 |
| 71,43 | 94,29 |
| 88,57 | 94,29 |
| 94,29 | 88,57 |
| 37,14 | 94,29 |
| 2,86 | 97,14 |
| 85,71 | 94,29 |
| 74,29 | 91,43 |
| 94,29 | 100 |
| 94,29 | 94,29 |
| 40 | 71,43 |
| 74,29 | 88,57 |
| 45,71 | 68,57 |
| 85,71 | 97,14 |
| 51,43 | 91,43 |
| 85,71 | 100 |
| 68,57 | 94,29 |
| 82,86 | 94,29 |
| 100 | 100 |
| 82,86 | 94,29 |
| 100 | 100 |
| 54,29 | 94,29 |
| 60 | 88,57 |
| 94,29 | 97,14 |
| 91,43 | 100 |
| 60 | 97,14 |
| 94,29 | 94,29 |
| 97,14 | 97,14 |
| 74,29 | 80 |
| 88,57 | 91,43 |
| 68,57 | 97,14 |
| 45,71 | 85,71 |
| 91,43 | 100 |
| 80 | 91,43 |
| 74,29 | 91,43 |
| 91,43 | 94,29 |
| 97,14 | 97,14 |
| 80 | 94,29 |
| 91,43 | 91,43 |
| 97,14 | 100 |

| Pre-test results | Post-test results |
|---|---|
| 88,57 | 100 |
| 82,86 | 94,29 |
| 88,57 | 91,43 |
| 80 | 91,43 |
| 82,86 | 91,43 |
| 80 | 82,86 |
| 57,14 | 85,71 |
| 40 | 71,43 |
| 100 | 97,14 |
| 68,57 | 65,71 |
| 40 | 91,43 |
| 94,29 | 100 |
| 28,57 | 94,29 |
| 65,71 | 97,14 |
| 85,71 | 97,14 |
| 57,14 | 80 |
| 97,14 | 100 |
| 48,57 | 88,57 |
| 82,86 | 82,86 |
| 91,43 | 85,71 |
| 45,71 | 85,71 |
| 74,29 | 97,14 |
| 65,71 | 77,14 |
| 40 | 91,43 |
| 68,57 | 94,29 |
| 82,86 | 97,14 |
| 100 | 100 |
| 100 | 94,29 |
| 91,43 | 97,14 |
| 82,86 | 100 |
| 85,71 | 100 |
| 85,71 | 100 |
| 54,29 | 97,14 |
| 88,57 | 94,29 |
| 85,71 | 100 |
| 94,29 | 97,14 |
| 31,43 | 82,86 |
| 51,43 | 91,43 |
| 97,14 | 100 |
| 77,14 | 88,57 |
| 62,86 | 88,57 |
| 82,86 | 97,14 |
| 80 | 91,43 |
| 60 | 80 |

| Pre-test results | Post-test results |
|---|---|
| 62,86 | 100 |
| 11,43 | 85,71 |
| 91,43 | 91,43 |
| 57,14 | 82,86 |
| 42,86 | 91,43 |
| 91,43 | 94,29 |
| 80 | 94,29 |
| 54,29 | 91,43 |
| 94,29 | 94,29 |
| 85,71 | 91,43 |
| 97,14 | 100 |
| 88,57 | 88,57 |
| 91,43 | 100 |
| 54,29 | 91,43 |
| 74,29 | 71,43 |
| 60 | 74,29 |
| 57,14 | 91,43 |
| 48,57 | 85,71 |
| 62,86 | 97,14 |
| 97,14 | 100 |
| 94,29 | 97,14 |
| 77,14 | 94,29 |
| 2,86 | 91,43 |
| 100 | 100 |
| 74,29 | 97,14 |
| 74,29 | 91,43 |
| 80 | 100 |
| 45,71 | 91,43 |
| 77,14 | 91,43 |
| 80 | 82,86 |
| 91,43 | 97,14 |
| 82,86 | 97,14 |
| 51,43 | 91,43 |
| 51,43 | 88,57 |
| 68,57 | 94,29 |
| 31,43 | 80 |
| 71,43 | 88,57 |
| 82,86 | 94,29 |
| 94,29 | 100 |
| 94,29 | 100 |
| 68,57 | 91,43 |
| 85,71 | 85,71 |
| 88,57 | 94,29 |
| 100 | 97,14 |

| Pre-test results | Post-test results |
|---|---|
| 82,86 | 94,29 |
| 42,86 | 88,57 |
| 45,71 | 77,14 |
| 62,86 | 85,71 |
| 71,43 | 97,14 |
| 91,43 | 100 |
| 91,43 | 97,14 |
| 68,57 | 97,14 |
| 88,57 | 97,14 |
| 94,29 | 88,57 |
| 65,71 | 97,14 |
| 85,71 | 97,14 |
| 94,29 | 91,43 |
| 68,57 | 80 |
| 97,14 | 100 |
| 94,29 | 94,29 |
| 91,43 | 97,14 |
| 60 | 100 |
| 97,14 | 100 |
| 91,43 | 97,14 |
| 91,43 | 94,29 |
| 82,86 | 80 |
| 88,57 | 91,43 |
| 42,86 | 94,29 |
| 74,29 | 97,14 |
| 85,71 | 100 |
| 100 | 100 |
| 94,29 | 97,14 |
| 80 | 88,57 |
| 88,57 | 88,57 |
| 60 | 94,29 |
| 94,29 | 97,14 |
| 100 | 94,29 |
| 88,57 | 94,29 |
| 74,29 | 97,14 |
| 65,71 | 94,29 |
| 62,86 | 65,71 |
| 82,86 | 94,29 |
| 97,14 | 100 |
| 45,71 | 60 |
| 62,86 | 85,71 |
| 62,86 | 91,43 |
| 80 | 91,43 |
| 100 | 100 |

| Pre-test results | Post-test results |
|---|---|
| 97,14 | 100 |
| 77,14 | 88,57 |
| 85,71 | 91,43 |
| 94,29 | 97,14 |
| 82,86 | 97,14 |
| 65,71 | 88,57 |
| 57,14 | 82,86 |
| 74,29 | 94,29 |
| 91,43 | 85,71 |
| 74,29 | 85,71 |
| 37,14 | 88,57 |
| 80 | 82,86 |
| 77,14 | 82,86 |
| 82,86 | 97,14 |
| 91,43 | 94,29 |
| 77,14 | 88,57 |
| 85,71 | 100 |
| 77,14 | 85,71 |
| 85,71 | 100 |
| 2,86 | 94,29 |
| 71,43 | 80 |
| 91,43 | 94,29 |
| 80 | 100 |
| 45,71 | 88,57 |
| 94,29 | 97,14 |
| 68,57 | 97,14 |
| 91,43 | 91,43 |
| 97,14 | 97,14 |
| 94,29 | 100 |
| 100 | 100 |
| 97,14 | 97,14 |
| 91,43 | 94,29 |
| 77,14 | 85,71 |
| 91,43 | 100 |
| 85,71 | 85,71 |
| 97,14 | 100 |
| 62,86 | 94,29 |
| 42,86 | 74,29 |
| 94,29 | 100 |
| 94,29 | 97,14 |
| 77,14 | 82,86 |
| 94,29 | 94,29 |
| 77,14 | 97,14 |
| 94,29 | 97,14 |

| Pre-test results | Post-test results |
|---|---|
| 88,57 | 97,14 |
| 88,57 | 91,43 |
| 48,57 | 97,14 |
| 65,71 | 88,57 |
| 94,29 | 97,14 |
| 85,71 | 97,14 |
| 97,14 | 100 |
| 85,71 | 100 |
| 88,57 | 97,14 |
| 77,14 | 91,43 |
| 74,29 | 74,29 |
| 100 | 100 |
| 88,57 | 97,14 |

## APPENDIX 2. Assessing users' acceptance of the e-learning questionnaire.

The survey questions related to the first level (reaction) according to Kirkpatrick's scale.

1. Did you like the course? Please, choose:
   - I definitely liked it,
   - I rather liked it,
   - I have no opinion,
   - I rather did not like it,
   - I definitely did not like it.

2. What do you plan to do with the knowledge gained during the schooling?
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ……………………………………………

3. Did you experience 'positive' or 'negative' emotions during the course? If yes, what kind?
   'Positive emotions':
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………
   'Negative emotions':
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ………………………………

4. Have you ever taken part in an e-course related to pharmacy continuing education?
   - YES,
   - NO.

5. If on question 4 you answered 'YES', please, choose "what do you think about the effectiveness of e-learning courses":

- they are definitely effective,
- they are rather effective,
- I have no opinion,
- they are rather ineffective,
- they are definitely ineffective.

6. Have you ever taken part in stationary courses related to pharmacy continuing education?
    - YES,
    - NO.

7. If on question 6 you answered ‘YES’, please, choose what do you think about the effectiveness of stationary courses:
    - they are definitely effective,
    - they are rather effective,
    - I have no opinion,
    - they are rather ineffective,
    - they are definitely ineffective.

8. What did you like the most in the completed course?
- the subject of the course,
- schooling movie,
- lecture,
- form of checking the knowledge,
- others: …………………………………………………………………………………………………

9. What did you like the least in the completed course?
- the subject of the course,
- schooling movie,
- lecture,
- form of checking the knowledge,

- others:
  ………………………………………………………………………………………………
  ………

The survey questions related to the second level (learning) according to Kirkpatrick’s scale.

1. Have you noticed the increase in your knowledge and skills after the course? Please, choose:
   - definitely yes,
   - rather yes,
   - I have no opinion,
   - rather not,
   - definitely not.

2. What new did you learn during the course?

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

# APPENDIX 3

1. Please, fill in the personal data:

Age:

Gender:

female

male

Regional Pharmaceutical Chamber: ……………………………………………………………….

Please, mark how big is the place where you live:

below 10 thousand inhabitants

from 10 to 30 thousand inhabitants

from 30 to 100 thousand inhabitants

over 100 thousand inhabitants

Do you take part in e-learning courses in your continuing education? Please, mark.

YES

NO

If you chose 'NO' in question 3, please, indicate, why you did not take part in e-learning courses in your continuing education:

I have limited access to the Internet

I find it difficult to attend courses via the Internet

I prefer direct contact with a course tutor

other; what? (please, answer below)

……………………………………………………………………………………………………
……………………………………………………………………………………………………

## APPENDIX 4

| Gender (1-male, 2-female) | Age | Regional Pharmaceutical Chamber | How big is the place where you live? (1-below 10.000 inhabitants, 2-from 10.000 to 30.000 inhabitants, 3-from 30.000 to 100.000 inhabitants, 4-over 100.000 inhabitants) | Do you take part in e-learning courses in pharmacy continuing education? (1-yes, 2-no) | If you chose 'no' in question 3, please, choose, why you do not take part in continuing e-learning courses (1-I have limited access to the Internet, 2-I have difficulties with taking courses via Internet, 3-I prefer direct contact with a tutor, 4-other, which? (open answer) |
|---|---|---|---|---|---|
| 2 | 27 | Krakow | 1 | 1 | |
| 2 | 55 | Krakow | 4 | 2 | 3; *'The necessity to pay the membership fee regularly.'* |
| 2 | 29 | Krakow | 4 | 1 | |
| 1 | 30 | Krakow | 4 | 2 | *'The lack of time but I am going to start.'* |
| 2 | 50 | Krakow | 2 | 2 | |
| 2 | 47 | Krakow | 2 | 1 | |
| 2 | 29 | Krakow | 3 | 1 | |
| 2 | 32 | Krakow | 4 | 1 | |
| 2 | 31 | Krakow | 4 | 1 | |
| 2 | 32 | Krakow | 4 | 2 | 3 |
| 2 | 27 | Krakow | 2 | 1 | |
| 2 | 26 | Krakow | 1 | 2 | 3; *'Short period of work, until now mainly direct courses.'* |
| 2 | 25 | Krakow | 4 | 1 | |
| 2 | 45 | Krakow | 2 | 2 | 3 |
| 2 | 26 | Krakow | 4 | 2 | 3 |
| 2 | 40 | Krakow | 4 | 2 | 3; *'I have no time for the Internet.'* |
| 2 | 29 | Krakow | 3 | 1 | |
| 1 | 33 | Krakow | 2 | 1 | |
| 2 | 27 | Krakow | 1 | 1 | |
| 2 | 33 | Krakow | 2 | 1 | |
| 2 | 25 | Krakow | 4 | 2 | *'I have just started to collect credits and I have not attended an e-learning course so far but for sure I will.'* |
| 2 | 58 | Krakow | 4 | 2 | 3 |
| 2 | 36 | Krakow | 4 | 2 | *'I come back to work after a holiday.'* |
| 2 | 31 | Krakow | 4 | 1 | |
| 2 | 29 | Krakow | 2 | 1 | |
| 2 | 27 | Krakow | 1 | 1 | |
| 2 | 40 | Krakow | 2 | 1 | |
| 2 | 27 | Krakow | 2 | 1 | |
| 2 | 25 | Krakow | 4 | 2 | 3 |
| 2 | 68 | Krakow | 4 | 2 | 1; 3 |

| Gender (1-male, 2-female) | Age | Regional Pharmaceutical Chamber | How big is the place where you live? (1-below 10.000 inhabitants, 2-from 10.000 to 30.000 inhabitants, 3-from 30.000 to 100.000 inhabitants, 4-over 100.000 inhabitants) | Do you take part in e-learning courses in pharmacy continuing education? (1-yes, 2-no) | If you chose 'no' in question 3, please, choose, why you do not take part in continuing e-learning courses (1-I have limited access to the Internet, 2-I have difficulties with taking courses via Internet, 3-I prefer direct contact with a tutor, 4-other, which? (open answer) |
|---|---|---|---|---|---|
| 2 | 27 | Krakow | 4 | 2 | 3 |
| 1 | 64 | Mazowiecka | 1 | 2 | 1; 3 |
| 2 | 30 | Beskidzka | 1 | 2 | 3; *'E-LEARNING COURSES. Courses are awful, condensation of specialised glossary on few pages which do not bring anything to professional practice. After that tests are even worse. You cannot easily cancel your registration on this platform, you have to call an administrator!'* |
| 2 | | Krakow | 3 | 1 | |
| 2 | 28 | Krakow | 4 | 1 | |
| 2 | 26 | Krakow | 4 | 1 | |
| 2 | 26 | Krakow | 1 | 1 | |
| 2 | 25 | Krakow | 4 | 1 | |
| 1 | 31 | Krakow | 2 | 1 | |
| 1 | 56 | Krakow | 1 | 2 | 3 |
| 2 | 33 | Krakow | 4 | 1 | |
| 2 | 27 | Krakow | 2 | 1 | |
| 2 | 29 | Krakow | 4 | 1 | |
| 2 | 38 | Krakow | 3 | 2 | 3 |
| 2 | 43 | Krakow | 3 | 1 | |
| 1 | 62 | Krakow | 3 | 2 | 3 |
| 2 | 26 | Krakow | 4 | 2 | *'My period to collect credits has already started. I think I have still time.'* |
| 1 | 26 | Krakow | 4 | 1 | |
| 1 | 25 | Krakow | 2 | 1 | |
| 1 | 25 | Krakow | 1 | 1 | |
| 2 | 27 | Krakow | 3 | 1 | |
| 1 | 32 | Krakow | 3 | 2 | 1 |
| 2 | 63 | | 3 | 2 | 3 |
| 2 | 51 | Krakow | 2 | 2 | 3 |
| 2 | 32 | Krakow | 3 | 2 | 1 |
| 2 | 36 | Krakow | 3 | 1 | |
| 1 | 26 | Krakow | 3 | 1 | |
| 2 | 36 | Krakow | 3 | 1 | |

| Gender (1-male, 2-female) | Age | Regional Pharmaceutical Chamber | How big is the place where you live? (1-below 10.000 inhabitants, 2-from 10.000 to 30.000 inhabitants, 3-from 30.000 to 100.000 inhabitants, 4-over 100.000 inhabitants) | Do you take part in e-learning courses in pharmacy continuing education? (1-yes, 2-no) | If you chose 'no' in question 3, please, choose, why you do not take part in continuing e-learning courses (1-I have limited access to the Internet, 2-I have difficulties with taking courses via Internet, 3-I prefer direct contact with a tutor, 4-other, which? (open answer) |
|---|---|---|---|---|---|
| 2 | 35 | Krakow | 2 | 1 | |
| 2 | 26 | Krakow | 4 | 1 | |
| 2 | 26 | Krakow | 4 | 2 | 3 |
| 2 | 26 | Krakow | 4 | 2 | *'Because of a short period of work. I have just started to be interested in the courses.'* |
| 1 | 33 | Krakow | 4 | 1 | |
| 2 | 29 | Krakow | 4 | 2 | 3 |
| 2 | 31 | Krakow | 4 | 1 | |
| 1 | 31 | Krakow | 4 | 1 | |
| 2 | 31 | Krakow | 4 | 1 | |
| 2 | 26 | Krakow | 1 | 2 | 3 |
| 2 | 31 | Krakow | 1 | 1 | |
| 2 | 29 | Krakow | 3 | 1 | |
| 2 | 28 | Krakow | 4 | 1 | |
| 2 | 60 | Krakow | 4 | 2 | 3 |
| 2 | 42 | Krakow | 4 | 1 | |
| 2 | 38 | Krakow | 4 | 1 | |
| 2 | 30 | Krakow | 4 | 1 | |
| 2 | 26 | Podkarpacka | 2 | 1 | |
| 2 | 27 | Krakow | 2 | 2 | 1 |
| 1 | 27 | Krakow | 2 | 1 | |
| 2 | 35 | Krakow | 2 | 1 | |
| 2 | 31 | Krakow | 2 | 1 | |
| 1 | 32 | Krakow | 2 | 1 | |
| 2 | 30 | Krakow | 2 | 1 | |
| 1 | 30 | Krakow | 4 | 1 | |
| 1 | 34 | Krakow | 4 | 1 | |
| 2 | 28 | Krakow | 4 | 2 | 2 |
| 1 | 28 | Krakow | 4 | 2 | 2 |
| 2 | 33 | Krakow | 4 | 1 | |
| 1 | 30 | Krakow | 4 | 1 | |
| 2 | 49 | Krakow | 4 | 2 | 2 |
| 2 | 27 | Krakow | 4 | 1 | |
| 2 | 28 | Krakow | 4 | 1 | |
| 2 | 25 | Krakow | 4 | 2 | 3 |
| 2 | 30 | Krakow | 4 | 1 | |
| 2 | | Krakow | 4 | 1 | |

| Gender (1-male, 2-female) | Age | Regional Pharmaceutical Chamber | How big is the place where you live? (1-below 10.000 inhabitants, 2-from 10.000 to 30.000 inhabitants, 3-from 30.000 to 100.000 inhabitants, 4-over 100.000 inhabitants) | Do you take part in e-learning courses in pharmacy continuing education? (1-yes, 2-no) | If you chose 'no' in question 3, please, choose, why you do not take part in continuing e-learning courses (1-I have limited access to the Internet, 2-I have difficulties with taking courses via Internet, 3-I prefer direct contact with a tutor, 4-other, which? (open answer) |
|---|---|---|---|---|---|
| 2 | 33 | Krakow | 4 | 1 | |
| 2 | 30 | Krakow | 4 | 1 | |
| 2 | 36 | Krakow | 4 | 1 | |
| 2 | 39 | Krakow | 4 | 1 | |
| 2 | 26 | Krakow | 4 | 1 | |
| 2 | 38 | Krakow | 4 | 1 | |
| 2 | 34 | Krakow | 4 | 1 | |
| 2 | 27 | Krakow | 4 | 2 | *'I have still time to collect credits.'* |
| 2 | 34 | Krakow | 4 | 1 | |
| 2 | 38 | Krakow | 4 | 1 | |
| 1 | 34 | Krakow | 4 | 2 | 3; *'At the beginning, I preferred via the Internet but now I prefer to listen live, always one can meet some familiar faces from studies and nice memories appear.'* |
| 2 | 29 | Krakow | 2 | 2 | 3 |
| 2 | 26 | Krakow | 3 | 1 | |
| 1 | 27 | Krakow | 3 | 1 | |
| 2 | 32 | Krakow | 2 | 1 | |
| 2 | 33 | Krakow | 4 | 1 | |