Ludovika - University of Public Service

Faculty of Public Governance and International Studies

Doctoral School of Public Administration Sciences

Validating E-Learning in Continuing Education for Public Servants and Pharmacists

Doctoral (PhD) Dissertation

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Formulation of the Scientific Problem

In the dissertation, the author investigates modern learning modes in continuing education among public administration servants and healthcare workers (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, public servants and pharmacists must keep their professional knowledge up-to-date to perform their tasks. It creates the need for continuing professional development.

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

Hypothesis

The author formed the hypothesis that **e-learning can be as efficient as on-site learning in conveying knowledge and skills** and 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?**

Research Objectives

The 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 1).
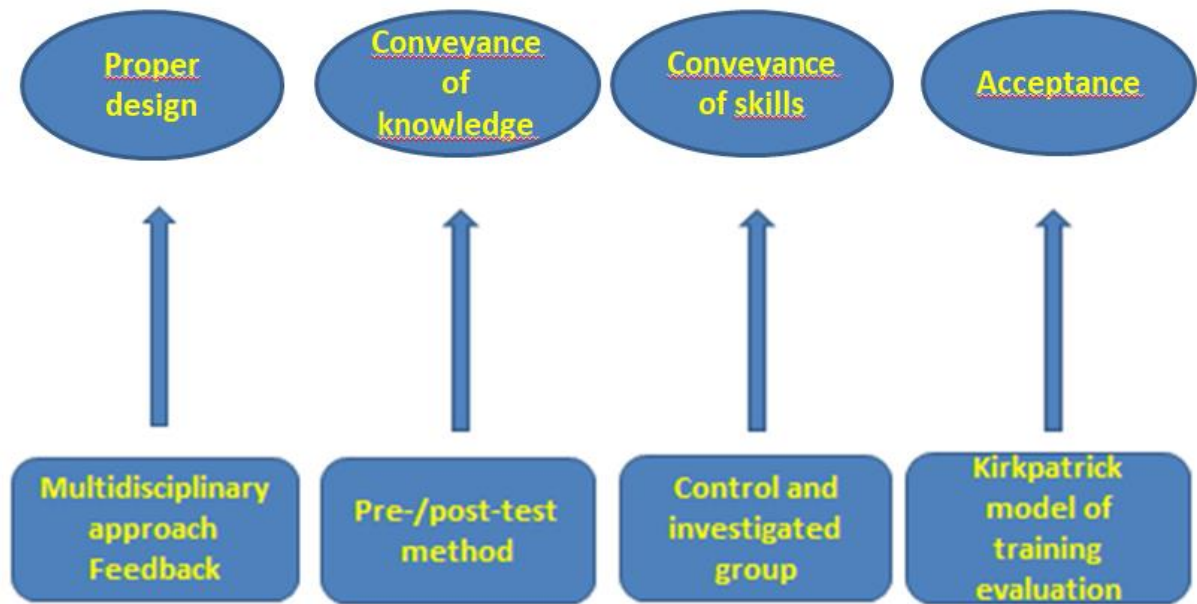
Figure 1. Visual representation of the research model.

Research Methods

An observational study was implemented, and feedback was gathered to explore 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 training evaluation model was implemented [Kirkpatrick D. L., Kirkpatrick J. D., 2006] to determine users' acceptance of e-learning courses.

The conveyance of knowledge was measured using 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).

The Kirkpatrick evaluation model is widely used among the known models for evaluating and analysing the results of educational and training programmes (Figure 2). 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.
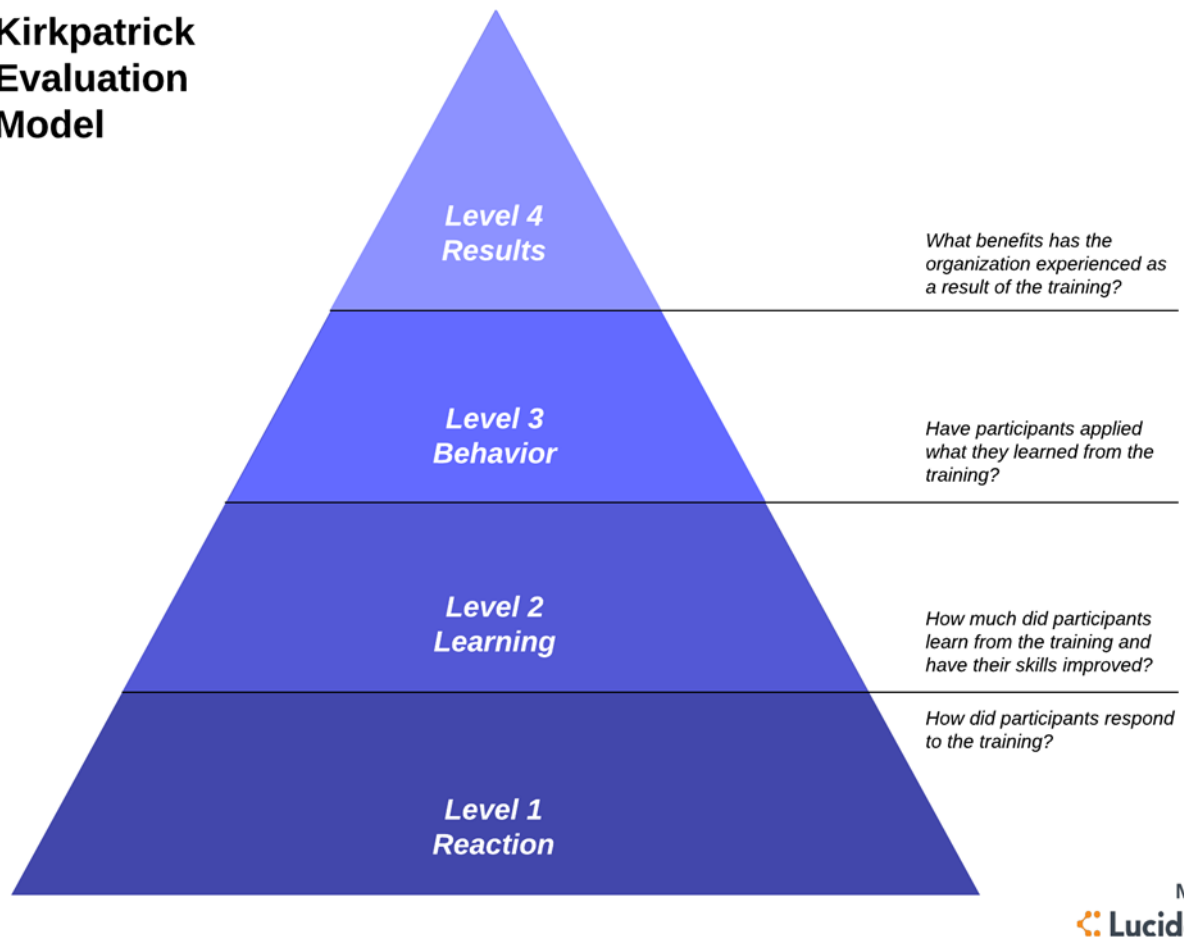
Figure 2. A visual representation of the Kirkpatrick evaluation model [Lucidchart Content Team, 2016].

Statistical Tools Used in Experiments

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 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**. **An analysis of covariance (ANCOVA)** was used to adjust the age gap between groups and changes in knowledge. 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. **The t-Student test** was used in the experiment related to conveying skills (precision of blood pressure measurement). 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. **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. **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.

Concise Description of the Study

The first chapter includes formulating the scientific problem, the hypotheses, and the research objectives and methods.

In the second 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, there is a description of Massive Open Online Courses and their role in training public servants with examples from different countries. There is also a description of blended learning and experiential e-learning. The author explores the issue of the high dropout rate in online courses and how it can be prevented. Further, the author investigates cheating prevention in online assessments and presents procurement tools used by various institutions worldwide. The last part is dedicated to the impact of the COVID-19 pandemic on distance learning.

The third 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. The author explores the role of technology-enhanced education in public service, particularly innovative training methods for public servants in Hungary, and the role of the Ludovika - University of Public Service as the hub of Hungary's public service development. The author presents 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.

The fourth 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. The hypothesis that a multidisciplinary team's design of e-learning courses was a success factor has been proved.

The conveyance of knowledge with the use of e-learning is the topic of the fifth chapter. In the introductory part, various tools to validate e-learning are presented: 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-tests. 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. The hypothesis that e-learning can be efficient in conveying knowledge has been proved.

The sixth chapter describes the study the author 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 in e-learning mode and the control one trained in 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. The hypothesis that e-learning can be used successfully in conveying skills has been proved.

Two studies focused on the acceptance of e-learning in continuing education among learners are presented in the seventh chapter. The author 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, the author compares pharmacists' satisfaction level with e-learning to on-site learning. The posed research question is: "What is the users' acceptance of e-learning compared to campus-based education?" [Nesterowicz K. *et al.*, 2016].

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**].**

The hypothesis that e-learning can be as accepted as campus-based learning by users has been proved.

Summarised Conclusions

If e-courses are to be practical 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, exploring the conveyance of skills using e-learning in continuing pharmacy education (CPE) [Nesterowicz K., 2012]. The study evaluated the effectiveness of an e-learning course over a campus-based one by measuring blood pressure 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 or campus-based courses demonstrated the same 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].

E-learning as a method of instruction for public employees has been introduced previously. Online learning activities have existed recently, although they largely supplement conventional on-site study. The E-learning Methodology Centre (EMC) had a new idea that included online courses without stationary educational components. In light of the lessons discovered from e-learning in public administration, the author must highlight two key findings concerning these initiatives. The first lesson is that **moving towards modern teaching and learning methods is not about technology**. **It remains crucial to deal with human factors like motivation, learning styles, and attitudes towards education.** EMC's main product is a learning experience where detailed, in-depth needs and impact evaluations are vital for training. 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 for creating new content for e-learning: simulation tools, future-related adaptive learning, and animated videos. The question is how far the adoption threshold could be pushed and the tolerance of newer and newer topics.

Four professional groups - methodology experts, IT developers, curriculum writers, and leaders - have formed a creative working space in the E-learning Methodology Centre, which helped produce over 100 e-learning courses for the Hungarian public service continuing education. **The multidisciplinary cooperation came out to be successful in producing many high-quality online courses in a proportionally short period.**

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, males tended to increase participation in e-learning (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 continuing education model. 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 continuing education 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].

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 a form of continuing education.

The gender distribution among users of e-learning platforms was 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**).

New Scientific Results

The main results of the scientific findings in the thesis are:

1) equal effectiveness in skill transfer via e-learning and stationary techniques,

2) multidisciplinary cooperation came out to be successful in producing many high-quality e-learning courses in a proportionally short period,

3) the knowledge test administered before and after the courses revealed that both modalities (e-learning vs on-site learning) were equally successful,

4) both public servants and pharmacists expressed high levels of acceptance and satisfaction with e-courses,

5) the gender distribution among users of e-learning platforms was likewise found to be unremarkable,

6) there was a significant age gap: younger people utilise e-learning platforms more often than their older counterparts.

Recommendations

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 participating in both experiments was reasonably high: 315 for the pre- and post-test and 238 for the acceptance questionnaire. Even with this, 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 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 conveying 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 the 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 the subject with a more significant number of participants.

The above research 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. It is the first step towards increasing knowledge and acceptance of e-learning in this user group (pharmacists in continuing education).

Technology integration in rich learning scenarios is a crucial research topic for the next 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 much discussion about technological integration these days, more actual work needs to be 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. 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 in the coming years. Because general problem-solving, reasoning abilities and self-directed learning skills are required to cope with rapid changes in technology and professions, research will increasingly 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 aim to learn 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. It 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].

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

Practical Applicability of the Research Results

When properly designed, e-learning is as efficient as on-site learning in transferring knowledge and some skills. Also, remote education's acceptance level is comparable to the campus-based one. Therefore, it is worth investing in such a learning mode. It can help institutions and companies save money they would spend on renting venues and didactic materials. Both learners and tutors can save time and travel costs to educational and training centres. E-learning courses enable to train great amount of learners from remote areas in a short time. It is especially beneficial for big international institutions and companies.

In the ÁROP project, multidisciplinary cooperation resulted in the production of many high-quality e-learning courses in a proportionally short period. It is worth having a group of experts from different fields (curriculum writers, teachers, IT specialists) while preparing e-learning courses.

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Scientific Biography of the Doctoral Candidate

Krzysztof Nesterowicz completed his Master's studies at the Faculty of Pharmacy, Jagiellonian University in Krakow, Poland. His research lies in the **effectiveness of e-learning compared to on-site learning**. He has continued research at the Doctoral School of Public Administration Sciences, Ludovika University of Public Service in Budapest. His research interests are **e-learning, technology-enhanced education and neuroscience.**

During his studies, Krzysztof was an active member of the European Pharmaceutical Student's Association (EPSA) as the Humanitarian Affairs Working Committee Director and representative at the European Council of Doctoral Candidates and Junior Researchers (Eurodoc).

He is an author and co-author of over 50 scientific articles; among them, over 20 are peer-reviewed international articles related to technology-enhanced education.

He remains the editorial board member or reviewer of such journals as 1) International Journal of Information and Communication Technology Education, 2) Journal of Educational Technology Development and Exchange, 3) International Journal of Research in Education Methodology, 4) BMC Medical Education, 5) Teaching and Learning in Medicine, 6) Journal of Medical Education and Training.

His native language is Polish. In addition, he speaks English, German and Italian at an advanced level and works as a Polish language teacher for foreigners.