Budapesti Corvinus
Egyetem

THESIS COLLECTION

Vitéz Nagy

E-learning evaluation methods

Ph.D. dissertation

Supervisor:

László Duma, Ph.D
associate professor

Budapest, 2020

Department of Infocommunication

THESIS COLLECTION

Vitéz Nagy

E-learning evaluation methods

Ph.D. dissertation

Supervisor:

László Duma, Ph.D
associate professor

Table of contents

1 Research background and rationale for the topic

My career related to e-learning started at the same time as my university studies, where I got into the world of e-learning both as part of charitable activity and as a professional career too – and as a person always ready to acquire new knowledge, I was constantly looking for such opportunities from the student side as well. By the time I got to the end of my MSc studies, I could confidently say that I wanted to research this topic at an academic level as well, and thanks to the practical experiences I gained during the years, I quickly found a subfield that had many unanswered questions on the topic.

1.1 Background and relevance of the subject

My specific research topic, which is the core of my dissertation, is the examination and elaboration of the measurement tools of the e-learning form of education. So far, no methodology has been developed for this, and I have not found the method used in traditional (attendance) education to be compatible for e-learning education.

One of the biggest difficulties of knowledge transfer is its measurability (not only in the case of e-learning, but also in the case of attendance training, as I will explain in more detail later). Exam situations are, of course, easy to simulate, and this way the degree of knowledge acquired can be tested, and the quality of education can

also be measured by the satisfaction of users (students, tutors, administrators, etc.), even if subjectively. (Wang, Wang & Shee, 2007) However, these measurement methods do not provide satisfactory answers to the questions I have formulated regarding the efficiency and effectiveness of knowledge transfer, as they examine the final state (the existence of knowledge), not the goodness of the process.

The topicality of the subject is best demonstrated by the fact that there is no accepted solution for measuring the efficiency and effectiveness of e-learning yet. Initiatives - such as the work of Favretto, Caramia & Guardini (2005) who examined the comparability of traditional and e-learning training, or Selim (2007) who analyzed the university adaptability of e-learning – can be found, but the measurements still focus on traditional, attendance education, and the toolkit used there also receives a lot of criticism, which I will summarize in more detail later.

At the same time, the need to set up a metric is growing, as with the continuous spread of technology and the "digitization" of generations, this form of education can be expected to grow in popularity from the student side as well, and on the business side, early adopters can even gain a competitive advantage by exploiting its potential. (Ruth, 2006) This, in turn, requires a unified measurement method and system that encourages decision-makers to open up towards this new field.

1.2   Research question and hypothesis

My research question in the dissertation is how / by what method can we measure the efficiency of e-learning from a knowledge transfer and from a financial-economic point of view. I aimed at developing a method that is suitable for measuring the efficiency and effectiveness of an e-learning training in its own right in terms of knowledge transfer. It is important to emphasize that with this I did not develop a toolkit for comparison with the traditional attendance course (or another e-learning course), because based on my research I was able to identify so many other influencing factors that make two different trainings "ceteris paribus" incomparable.
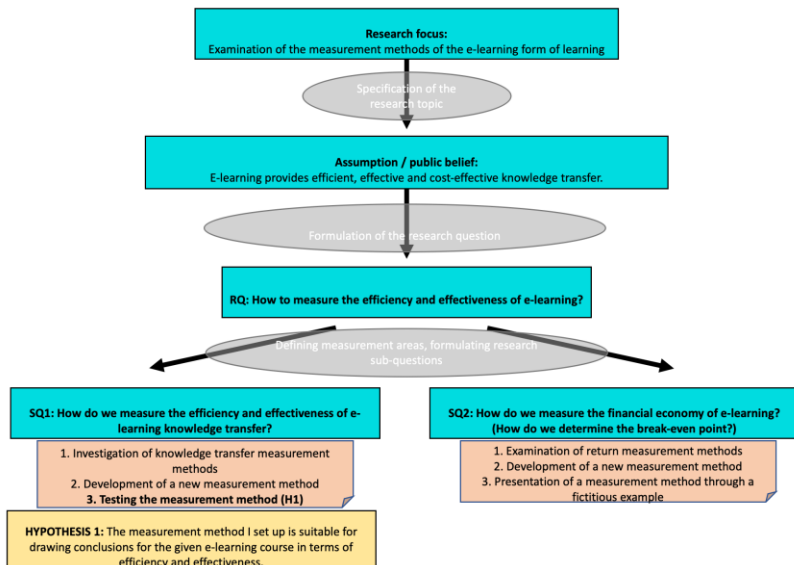
The focus of my research is to examine the efficiency and effectiveness of the e-learning form of education, which has both knowledge transfer and financial implications. The basic assumption is that knowledge transfer through the form of e-learning is more efficient and effective (see the explanation of the concepts later in the development of methods) and can be more economical (i.e. more financially efficient) than traditional classroom education.

Central research question: How do we measure the efficiency and effectiveness of e-learning?

- **1. research sub-question:** How do we measure the efficiency and effectiveness of e-learning knowledge transfer? – Through research of professional literature, I examined the available measurement solutions, set up a set of criteria for developing a good measurement method, and then developed methods for measuring the efficiency and effectiveness of e-learning education.

- **2. research sub-question:** How do we measure the financial economy of e-learning? (In other words, how do we determine its break-even point?) – Based on my experience in the profession and on professional literature, I determined the cost system of the two forms of education, and based on these, I developed a calculation method to determine the break-even point of the e-
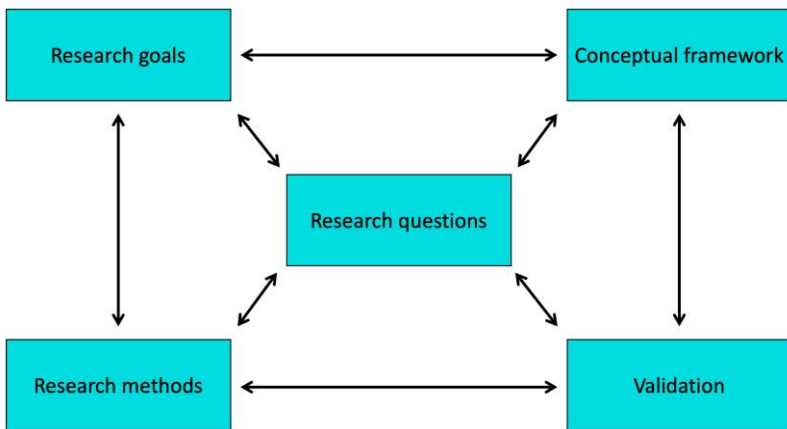
learning form of education compared to classroom education. Finally, I applied the developed method of return calculation to the indicators of a (fictitious) e-learning investment training I created, and thus I located its break-even point.

<u>The hypothesis of my dissertation is as follows</u>: The unique measurement method I have set up is suitable for drawing conclusions for the given e-learning course in terms of efficiency and effectiveness.

To investigate this, I applied the new, unique measurement method developed along the first research sub-question in practice to a data set extracted from an e-learning course, and I analyzed the efficiency and effectiveness of knowledge transfer in this course with quantitative tools. **The uniqueness of the method stems from three factors: (1)** no method for measuring e-learning efficiency has yet been developed in professional literature; **(2)** no control group is required for the measurement, the selected course becomes evaluable in itself; **(3)** the measurement method does not rely on subjective analysis (e.g. questionnaire text analysis), but calculates from objective, machine-recorded indicators using mathematical methods. It is important to note that general conclusions about e-learning could only be drawn after many similar studies, but this was not the purpose of the present dissertation; as neither was the examination of the relationship between the two branches.

2   Methods used

I designed my research with an interactive model where research goals, conceptual frameworks, research methods, and validation interact with the central research questions. I developed the interactive model of research design based on the work of Maxwell & Loomis (2003).

```
┌─────────────────┐                    ┌─────────────────────┐
│  Research goals  │ ←───────────────→ │ Conceptual framework │
└─────────────────┘                    └─────────────────────┘
          ↕            ↖  ┌────────────────────┐  ↗            ↕
                          │ Research questions  │
                       ↙  └────────────────────┘  ↘
┌─────────────────┐                    ┌─────────────────────┐
│ Research methods │ ←───────────────→ │     Validation       │
└─────────────────┘                    └─────────────────────┘
```

I also used qualitative and quantitative tools for the whole research: for the methodological elaboration I mainly used an extensive literature review and synthesis, while the testing and validation of the methodologies was performed on data sets by quantitative analysis with the help of the new, unique measurement systems developed by me.

3 Results of the dissertation

In this chapter, I present the most important results of the dissertation, which can be summarized by focusing on four main areas:

1. Conceptual clarification of the e-learning ecosystem both at an international level and taking into account the peculiarities of the Hungarian language, in the framework of an extensive literature review.

2. Development of a new measurement method for the efficiency and effectiveness of e-learning knowledge transfer.

3. Development of a new measurement method to calculate the break-even point of the e-learning form of education.

4. Testing and evaluation of the measurement method developed in the third point through real practical examples and empirical research.

In the spirit of transparency and easy interpretation, I summarized the central result of the dissertation in one paragraph:

In the dissertation I set up a metric (measurement system) based on the characteristics of e-learning, and I also

validated it within the framework of the dissertation. My goal was to give the field of e-learning a tool to evaluate the effectiveness and efficiency of this form of education. The aim of the empirical research carried out in the dissertation was to examine the applicability of the method in a real environment, which shed light on its limitations and possibilities for expansion and further development.
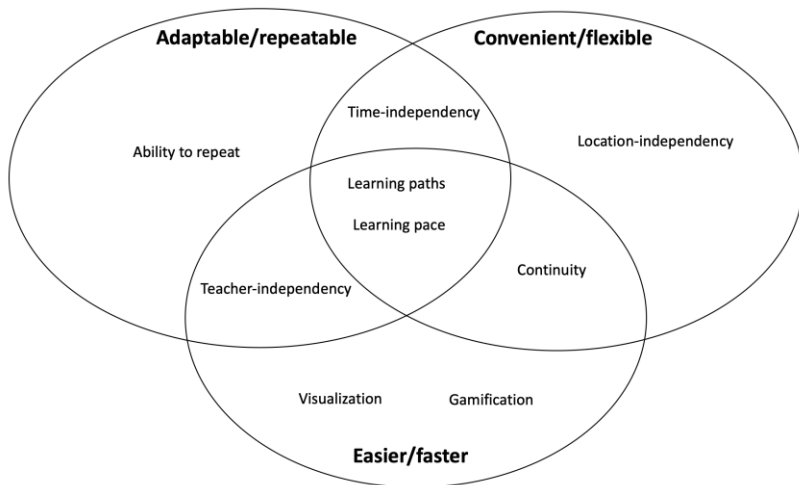
3.1 Conceptual clarification, literature review

Due to the novelty of e-learning, I consider it important to form a comprehensive picture of the e-learning ecosystem as the first step of my research: in this context, I examined the current trends of the e-learning market and also explained some approaches in professional literature to define the concept of e-learning. Using this experience, I also attempted to formulate my own definition of e-learning: **the form of e-learning provides a learning opportunity that is unrestricted in space and time, which enables learning independently of the tutor by using digital solutions**.

As a next step, one step further from the specific definition of e-learning, I examined its components and constituents: **the e-learning system, e-learning content and e-learning personas**. In addition to the conceptual definitions, I outlined their connection points and detailed the role of e-learning components in the e-learning ecosystem.
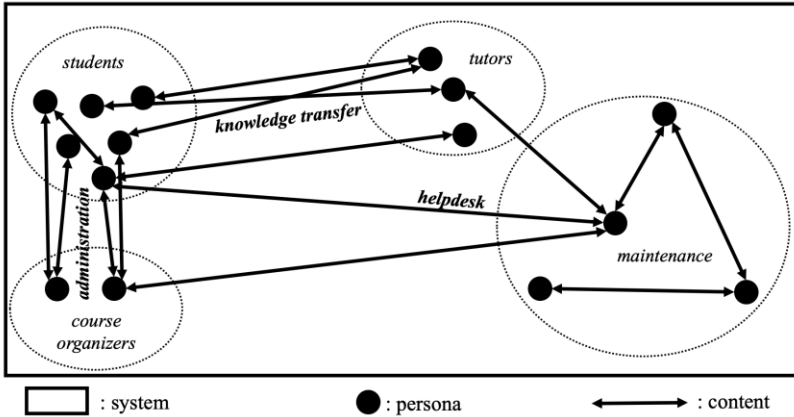
As a final step to get an even broader and more accurate picture of the e-learning ecosystem, I examined additional concepts and expressions that are in some way related to the world of e-learning, drawing the network and connections of these additional concepts: blended learning, mobile learning, distance learning.

Finally, I made a thorough comparison with the surrogate and complementary service of e-learning: attendance education, which I summarized, categorized, and illustrated in 9 points.

Venn diagram showing three overlapping ellipses labeled **Adaptable/repeatable**, **Convenient/flexible**, and **Easier/faster**, with terms: Time-independency, Location-independency, Ability to repeat, Learning paths, Learning pace, Teacher-independency, Continuity, Visualization, Gamification.

3.2 Development of an e-learning knowledge transfer measurement method

The primary goal of my research was to find a measurement method that is suitable for measuring the efficiency of e-learning courses in terms of knowledge transfer without being able to compare them to any control group. As such a measurement method did not yet exist, I first examined the expectations and requirements for good measurement methods in general, and then I examined the measurement tools used in classroom (attendance) courses as a good practice and starting point – and I also expressed my criticisms of them, which were mainly about its subjectivity and tutor-centredness.

Based on these experiences, I developed a method based on mathematical and statistical methods, which, thanks to the IT background provided by e-learning, made use of the opportunities

provided by automated and digital data recording. I also provided a tool to calculate the efficiency and effectiveness of the e-learning form of education from two approaches:

1. **Knowledge transfer-centric measurement method;**

2. **Result-based measurement method.**

The *knowledge transfer-centric measurement method* primarily analyzes the behavior of e-learning users with **dispersion, kurtosis and skewness indicators**. My basic assumption according to the measurement method is based on the central limit theorem, according to which observations depending on many factors typically approach a normal distribution. Based on this, **I assumed that participation in a completely average e-learning course was normally distributed, and I examined the nature of the deviations from it with the above indicators**.

The *result-based measurement method* **compares the results of the students' input knowledge assessment test and the final score at the end of the e-learning course, and characterizes the knowledge transfer between the two with a unique activity indicator**. Analyzing the correlations between these three variables **with correlation and regression calculations and clustering procedures, and the joint interpretation of these studies**, we can also get an idea of the goodness of the e-learning course.

3.3 Development of the e-learning break-even point calculation

In order to be able to fully evaluate an e-learning course, in addition to knowledge transfer, I also found it necessary to **examine its material and financial implications**. There is no use of an e-learning course that is extremely effective in providing knowledge transfer if the cost of producing the course far exceeds the cost of a classroom with the same professional content. People facing such decisions will need both sets of information, so I also developed a method for calculating the e-learning break-even point.

To do this, I first examined the specifics and cost structure of e-learning development projects, which I compared with the typical expenditures of attendance education. The main conclusion of this is that **attendance training has uniformly distributed even expenses with the tutor and classroom rental costs, while e-learning has a significantly lower maintenance cost after the initial investment**.

	One time			**Continuous**
Framework (LMS)	Introduction of framework (human cost of IT investment)			Framework version upgrade
	One-time application fee	(or)		License fee (can be free)
	Server investment	(or)		Hosting service
	-			Support / helpdesk function
Curriculum (content)	Curriculum development (human cost of investment)			Curriculum maintenance (content update)
	One-time software cost			License fee
	-			(Professional support for students)

Along this, I set up a method for calculating the break-even point, which determines the break-even point of the investment in e-learning, measured in years. I did not examine this method with empirical data, but I demonstrated its applicability in practice through the example of a fictitious case generated by me.

3.4 Testing and evaluating the method of measuring knowledge transfer

The hypothesis formulated in my dissertation was that the method I developed, which measures the efficiency and effectiveness of knowledge transfer, is suitable for drawing conclusions about the goodness of e-learning. To prove this, we converted one of the subjects of the Corvinus University of Budapest to e-learning form, and I fitted the data generated and collected in the Moodle e-learning system of the University to the measurement methods.

I divided the evaluation of the measurement method into 3 phases: first I examined whether the **data fitted properly**, then I examined the **usefulness of the conclusions that can be drawn from the measurement methods**, and thirdly I formulated **remarks, criticisms and suggestions for further development**. After proper preparation and cleansing of the data, I successfully fitted them to both the knowledge transfer-based and result-based measurement methods. I managed to draw interpretable and usable conclusions about the e-learning course, so I considered the developed measurement method to be suitable and my hypothesis to be justified. Finally, the suggestions and critiques formulated in the last step make the measurement method suitable for fine-tuning and further development.

4   Summary of conclusions

In this chapter, I will summarize the scientific results achieved in the dissertation.

T1: I examined the conceptual approaches to e-learning, created my own definition of e-learning, identified the components and related concepts of e-learning, and finally defined the 9 distinguishing features of attendance education.

T2: I developed a toolkit for measuring e-learning knowledge transfer objectively that can be used without a control group, which puts the measurement of efficiency on a mathematical-statistical basis from the data automatically recorded by e-learning systems.

T3: I developed a method for calculating the break-even point of e-learning projects, which compares the costs of e-learning implementation to attendance training, thus determining the time period measured in years from which the investment in e-learning pays off.

T4: I tested the method and toolkit measuring the efficiency of e-learning knowledge transfer, I established its general applicability, and I formulated the limitations and further development possibilities of the measurement method.

5 Key references

Bartley, S. J., & Golek, J. H. (2004). Evaluating the cost effectiveness of online and face-to-face instruction. *Journal of Educational Technology & Society*, *7*(4), 167-175.

Berk, R. A. (2005). Survey of 12 strategies to measure teaching efficiency. *International Journal of Teaching and Learning in Higher Education, 17*(1), 48-62.

Bresee, C. W. (1976). On "Grading on the Curve". *The Clearing House*, *50*(3), 108-110.

Clark, T. A. (1989). Distance education: its effectiveness and potential use in lifelong learning. *Lifelong learning*.

Creemers, B. P., & Kyriakides, L. (2006). Critical analysis of the current approaches to modelling educational efficiency: The importance of establishing a dynamic model. *School Efficiency and School Improvement, 17*(3), 347-366.

Duma, L., & Nagy, V. (2018). Curve-based e-learning efficiency grading. *Vezetéstudomány-Budapest Management Review, 49*(11), 45-54.

Emery, C. R., Kramer, T. R., & Tian, R. G. (2003). Return to academic standards: A critique of student evaluations of teaching efficiency. *Quality Assurance in Education, 11*(1), 37-46.

Favretto, G., Caramia, G., & Guardini, M. (2005). E-learning measurement of the learning differences between traditional lessons and online lessons. *European Journal of Open, Distance and e-Learning, 8 (2)*.

Galbraith, C. S., Merrill, G. B., & Kline, D. M. (2012). Are student evaluations of teaching efficiency valid for measuring student learning outcomes in business related classes? A neural network and Bayesian analysis. *Research in Higher Education, 53*(3), 353-374.

Guri-Rosenblit, S., & Gros, B. (2011). E-learning: Confusing terminology, research gaps and inherent challenges. *International Journal of E-Learning & Distance Education*, *25*(1).

Guskey, Thomas R. (2011). Grading reform. *Educational Leadership,* 17-21.

Holsapple, C. W., & Lee-Post, A. (2006). Defining, assessing, and promoting e-learning success: An information systems perspective. *Decision Sciences Journal of Innovative Education*, *4*(1), 67-85.

Krašna, M., Bratina, T., & Kaučič, B. (2009). Implementation of distance learning materials. In *Computers in Education, 32nd International Convention* (pp. 149-154). MIPRO.

Kronholz, J. (2012). Can Khan Move the Bell Curve to the Right?. *Education Next,* 12.2.

Lynch, M. M., & Roecker, J. (2007). *Project managing e-learning: A handbook for successful design, delivery and management*. Routledge.

Mittal, A., Krishnan, P. V., & Altman, E. (2006). Content classification and context-based retrieval system for e-learning. *Journal of Educational Technology & Society*, *9*(1), 349-358.

Monda, E. (2014). eLearning sikertényezők. Egy eLearning projekt elemzése. *Információs Társadalom*, *14*, 29-51.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same?. *The Internet and Higher Education*, *14*(2), 129-135.

Nagy, V. (2016). E-learning ABC. *Vezetéstudomány-Budapest Management Review, 47*(12), 6-15.

Nesterowicz, K., Neacsu, A., Fereshtehnejad, S. M., & Nemeslaki, A. (2016). Exploring the acceptance of e-learning in continuing pharmacy education. *Pharmacy Education*, 16.

Ruth, S. R. (2006). E-learning-a financial and strategic perspective. *Educause Quarterly*, *29*(1), 22.

Sangrà, A., Vlachopoulos, D., & Cabrera, N. (2012). Building an inclusive definition of e-learning: An approach to the conceptual framework. *The International Review of Research in Open and Distributed Learning*, *13*(2), 145-159.

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

Strother, J. B. (2002). An assessment of the efficiency of e-learning in corporate training programs. *The International Review of Research in Open and Distributed Learning*, *3*(1).

Tyler, L. (2010). Measuring teaching effectiveness. Education Week, 29(19), 18.

Vilaseca, J., & Castillo, D. (2008). Economic efficiency of e-learning in higher education: An industrial approach. *Intangible Capital*, *4*(3), 191-211.

Volery, T., & Lord, D. (2000). Critical success factors in online education. *International journal of educational management*, *14*(5), 216-223.

Wall, C. R. (1987). Grading on the Curve. *InCider*, *5*(10), 83-85.

Wang, Y. S., Wang, H. Y., & Shee, D. Y. (2007). Measuring e-learning systems success in an organizational context: Scale development and validation. *Computers in Human Behavior*, *23*(4), 1792-1808.

6 Own publications on the subject

6.1 Studies published in referenced professional journals

1. Nagy, V. (2016). E-learning ABC. *Vezetéstudomány-Budapest Management Review*, *47*(12), 6-15.

6.2 Studies published in scientific books, book chapters, peer-reviewed conference proceedings

2. Nagy, V. (2016). Az e-learning bevezetés komplexitása - egy példa a magyar piacról. *In: Keresztes, Gábor (szerk.) Tavaszi Szél 2016 Tanulmánykötet, II. kötet: Hittudomány, irodalomtudomány, kémia- és környezettudomány, kommunikáció-tudomány, közgazdaságtudomány*, Budapest, Magyarország: Doktoranduszok Országos Szövetsége, (2016) pp. 400-409., 10 p.

3. Nagy, V. (2015). Videó alapú e-learning tananyagok fejlesztése automatizáltan? *In: Námesztovszki, Zsolt; Vinkó, Attila (szerk.) XXI. Multimédia az oktatásban és II. IKT az oktatásban konferencia*, Szabadka, Szerbia: Újvidéki Egyetem Magyar Tannyelvű Tanítóképző Kar, (2015) pp. 126-130., 5 p.

6.3 Other studies

4. Nagy, V. (2016). Az e-learning tananyagok technológiai kihívásai és korlátai. *In: Berke, József (szerk.) XXII. "Multimédia az Oktatásban": nemzetközi konferencia*, Keszthely, Magyarország: Balatoni Múzeum, (2016) pp. 128-132., 5 p.

5. Balkányi, P., Orbán, Zs., Nagy, V. (2016). Nagyvállalati E-Learning – A Képzésmenedzsmenttől Az Infotainment-Ig. *In Hülber, L. (Szerk.) I. Oktatásszervezési És Oktatásinformatikai Konferencia*, ISBN: 978-615-5621-14-7, Pp.48., Eszterházy Károly Egyetem, Eger

6.4 Publications in foreign languages

6. Nagy, V. (2019). Cluster Analysis in a Language School's E-learning Program. *In: Borsos, É; Horák, R; Kovács, C; Námesztovszky, Zs (szerk.) Mobilitás: A Magyar Tannyelvű Tanítóképző Kar tudományos konferenciáinak tanulmánygyűjteménye*, Szabadka, Szerbia: Újvidéki Egyetem Magyar Tannyelvű Tanítóképző Kar, Szabadka, (2019) pp. 646-652., 7 p.

7. Duma, L., & Nagy, V. (2018). Curve-based e-learning efficiency grading. *Vezetéstudomány-Budapest Management Review*, *49*(11), 45-54.

8. Orbán, Zs., Nagy, V., Balkányi, P. (2015). E-Learning Based Education And E-Skill Development At The Public Service. *In Balthasar, A., Golob, B., Hansen, H., Kőnig, B., Müller-Török, R., Prosser, A. (Szerk.) Central And Eastern European E/Dem And E/Gov Days 2015: Time For A European Internet?* ISBN: 978-2-85403-308-0, Pp.579-594., Andrássy Gyula Budapesti Német Nyelvű Egyetem, Budapest

9. Nagy, V., Orbán, Zs. (2014). Issues and work flow in connection with production of e-learning materials: What kind of tools and experts supported the creation of e-learning materials? *The 22nd NISPAcee Annual Conference*, Budapest, 2014.