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Development and evaluation of methodological measures related to teachers' digital competence

Introduction

Learning and skills are key contributors to society and the economy. As modern societies and economies are changing due to, amongst others, globalization and technological progress, a fundamental transformation of education and training (E&T) throughout Europe is required to deliver the knowledge and skills needed for growth, employment and participation in society. Those forms are an important part of the Europe 2020 agenda and its various flagships and policy initiatives (Learning and Skills for the Digital Era, 2018). Special attention of EU policy and research in this area started in 2005 and is focused on how to make better use of ICT for rethinking learning, for innovating education and training and for addressing new skills requirements (e.g. digital competence) to generate growth, employment and social inclusion.

This article is an attempt to analyze theoretical grounding and methodological issues for conducting a study of levels of teachers' digital competences and ways for their improving.

The European Commission emphasized the potential of ICT to encourage innovation in approaches to teaching and learning. The opportunities provided by ICT (e.g. networking, interaction, information retrieval, presentation and analysis) are seen as core elements in honing 21st century skills. This also required a more comprehensive embedding of ICT and its pedagogical use in the curriculum for students as well as in teacher training. Teaching staff are the key players in strengthening and fostering the new digital environment in schools.

Digital competence of educators

Innovating and modernizing education and training are key priorities in several flagship initiatives of the Europe 2020 strategy, in particular Agenda for New Skills and Jobs, Youth on the Move, the Digital Agenda and the Innovation Union. The key challenge for research and policy is to make sure that the full potential of digital technologies is used for learning and that effective digital-age learning is made possible through systemic and holistic change (Digital Competence Framework for Educators, 2018).

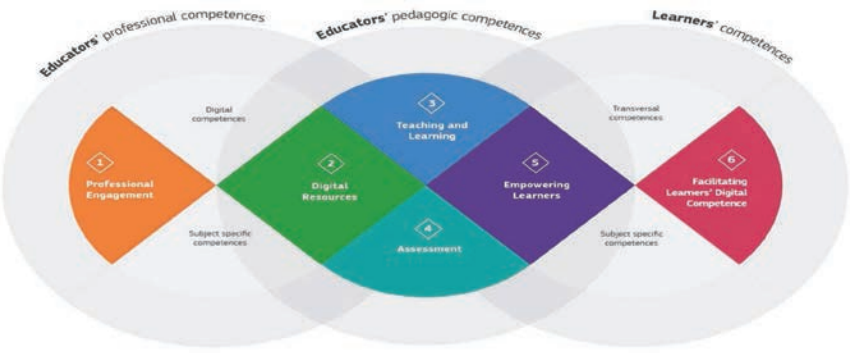

Fig. 1 Digicompedu in a nutshell (according to European Framework for the Digital Competence of Educators, 2018)

The ubiquity of digital devices and applications, in particular, requires educators to develop their digital competence (Fig. 1).

Strengthening education systems through the use of new ICT tools and teacher training is one of the priority areas for the first cycle of the Strategic Framework for education and Training ('ET 2020') (Key Data on Learning ..., 2011). In addition, the Digital Agenda for Europe initiative defines the enhancement of digital literacy and skills as one of its main pillars and promotes the implementation of long-term e-skills and digital literacy policies (Digital Agenda for Europe, 2018).

According to the study conducted recently by Polish scientists (The digitalization of Polish Education Vision and Proposals, 2018) there are three areas of professional pedagogical digital competence of teachers that should be developed for making progress with digitalization in Polish education/school: subject-matter, methodological and technological competences. These digital key competences become a new fourth cultural technique, alongside writing, reading and arithmetic (Landesregierung NRW, 2016).

Effective science and practical communication, which ensures an efficient flow of information about new in the area of teacher training, using of the new teaching and learning digital techniques, has a direct impact on the development of each scientific direction, practical introduction of the scientific results and to improve teacher professional development.

For promoting economic competitiveness and social cohesion European society needs an educational infrastructure that provides all learners with opportunities to obtain an education at the highest level commensurate with their own growth and growth potential (Niemi, 2007). The European Commission emphasized the potential of ICT to encourage innovation in approaches to teaching and learning (European Commission, 2008). The opportunities provided by ICT (e.g. networking, interaction, information retrieval, presentation and analysis) are seen as core elements in honing 21st century skills. This also required a more comprehensive embedding of ICT and its pedagogical use in the curriculum for students as well as in teacher training (Key Data on Learning..., 2011).

Teaching staff are the key players in strengthening and fostering the new digital environment in schools. It is vital that the European Union needs well-trained teachers, able to incorporate ICT into education in a way that leads to change from the old to the new paradigms of learning which are much more student-centered than before (Learnovation Consortium, 2008). European Member States have recognized the importance of teacher education in this context. They have committed themselves to developing ICT skills during initial teacher education and to continue to encourage this through early career support and continuing professional development.

It is evident that there is an urgent need for action regarding the professionalization of teachers for digitization (Zimmermann et al, 2019). This goal can only be achieved by systematically building up or broadening media-didactic competences in continuing education and training programs (Bastian et al., 2016; Instefjord, 2015). Therefore, it is also of great importance to identify and formulate the exact mechanisms for changing teachers' attitudes towards digital teaching techniques and ways of their motivation for the professional development especially in area of technological and pedagogical competences in the context of the required digitization in schools.

Overview of underpinning theories for theoretical backgrounding of the study concerning development of teachers' digital competences

The gap between theory and practice in teacher education is widely discussed (Korthagen et al., 1999; Shulman, 1998). Evidence suggests that teachers competences interventions guided by relevant theory (e.g. the concept of individual technology acceptance (Davis,1986), the theory of reasoned action (Fishbein et al., 1975), the unified theory of acceptance and use of technology (Venkatesh, 2003) are more effective in changing teachers' attitudes towards using new technologies and improving their pedagogical competences including digital skills.

These theories hypothesize that there are four core constructs which direct determinate behavioral intention (performance expectancy, effort expectancy, social influence and facilitating. in turn, these constructs are moderated by gender, age, experience and voluntariness of use (Venkatesh et al., 2003).

Badura's social cognitive theory (Badura, 1986) and Self-efficacy theory (Badura, 1997) as well as Theory of Planned Behaviour (Ajzen, 1985) also look useful for the study of ways for changing teachers' motivation for professional development.

Social cognitive theory is concerned with the process of knowledge acquisition or learning. This theory is based on the idea that people learn by observing others, with the environment, behavior and cognition as the chief factors influencing development in a reciprocal triadic relationship.

According to the Self-efficacy theory observed behavior of an individual is influenced by three basic determinants, which are personal, behavioral and environmental. Badura names four sources of efficacy beliefs:

1. Mastery experiences. However nothing is more powerful than having a direct experience of mastery to increase self-efficacy. Having success, for example in mastering a task or controlling an environment, will build self-belief in that area whereas a failure will undermine that efficacy belief. To have a resilient sense of self-efficacy requires experience in overcoming obstacles through effort and perseverance.

2. Vicarious Experiences. Seeing people similar to ourselves succeed by their unstained effort raises people beliefs that they too possess the capabilities to master the activities needed for success in that area.

3. Verbal Persuasion. Influential people such as colleagues, teachers, managers or coaches can strengthen people beliefs that they have what it takes to succeed.

4. Emotional and Physiological States. The state person is in will influence how he or she judges his or hers self-efficacy. Stress reactions or tension are interpreted as signs of vulnerability to poor performance whereas positive emotions can boost people confidence in their skills.

5. Imaginal Experiences. The art of visualizing yourself behaving effectively or successfully in a given situation.

Self-efficacy is the belief in one's ability to influence events that effect one's life and control over the way these events are experienced (Bandura, 1994).

According to the Theory of Planned Behavior (Ajzen, 1985), an intention to a behavior depends on one's attitude, normative beliefs, and control beliefs about that behavior. These include beliefs about perceived consequences, others' expectations and resources or barriers for that behavior. How much each of these beliefs affect the intention towards the behavior, depends on their power in any individual's case. An estimate of whether a perceived consequence is good or bad amplifies the attitude component. Similarly, motivation to comply with a certain group puts gain on the belief about the expectations of that group. Each resource required by, or barrier against, a behavior needs to be multiplied by an estimation of one's potential to overcome these. Multiplying the strength of each salient belief by its estimated individual power can be then determine the direct variables for the attitude, subjective norm and perceived behavioral control as averages. The behavior depends on the intention to the behavior, which in turn, is dependent on these direct variables. Further, the weight of each of these is still dependent on external variables of demography, general attitudes and personal traits, for example.

Other group of the theories grounded the necessary professional knowledge of teachers for the use of technologies in teaching. The most appropriate are Shulman's pedagogical content knowledge (PCK) model (Shulman, 1986) and Mishra's and Koehler's Technological pedagogical content knowledge (TPACK) model (Mishra et al., 2006).

Shulman's model is based on two main dimensions: pedagogical knowledge (PK) and content knowledge (CK). According to this model, teachers' subject matter knowledge and pedagogy were being treated as mutually exclusive. Pedagogical content knowledge includes pedagogical knowledge and content knowledge, among other categories. Initial Shulman's description of teacher knowledge included curriculum knowledge, and knowledge of educational contexts.

Extending PCK model to the phenomenon of teachers integrating technology into their pedagogy allowed Mishra and Koehler to frame Technological pedagogical content knowledge (TPACK) model, which focuses on technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK) and offers a productive approach to many of the dilemmas that teachers face in implementing educational technology in their classrooms. By differentiating among these three types of knowledge, the TPACK framework outlines how content (what is being taught) and pedagogy (how the teacher imparts that content) must form the foundation for any effective edtech integration (Kurt, 2018). This order is important because the technology being implemented must communicate the content and support the pedagogy in order to enhance students' learning experience. The professional knowledge of teachers includes content knowledge (CK): knowledge about facts, concepts or structures of a specific subject and in the same time it comprises pedagogical knowledge (PK), which describes the knowledge for teaching and learning (Fig. 2).

These different forms of knowledge areas could be additionally linked to the respective context, i.e. the situational conditions, such as the interior design, the classroom climate or the school concept (Mishra et al., 2006). Some studies concluded that the number and the type of TPACK factors depend on the investigated population (Cubeles et al.,2018).

Testing the validity of theoretical models applied to educational interventions allows for the development and refinement of theory, which can support the design and delivery of more effective interventions. However, interventions targeting digital competences in teachers and students of Polish educational institutions rarely assess the theoretical mechanisms of behavioral changes in relation to motivation for professional development.

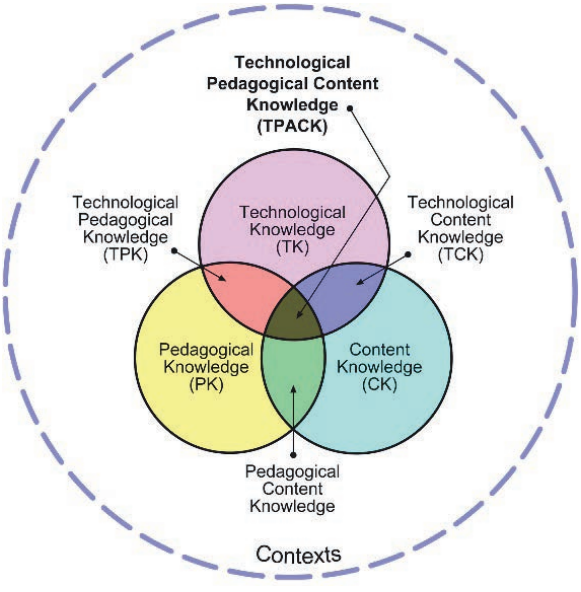

Figure 2. Structure of the TPACK model (image ©2012 by tpack.org)

Methodology

The study survey was designed using the questionnaire for self-reflection, based on European competence framework for the digital competence of educators (Digital competence framework for educators, 2018). According to the Digcompedu framework there are 22 educator-specific digital competences organized in 6 areas which are focused on different aspects of educators' professional activities (table 1).

Table 1. Areas of educator-specific digital competences

Area	Description
I. Professional Engagement	Using digital technologies for communication, collaboration and professional development
II. Digital Resources	Sourcing, creating and sharing digital resources
III. Teaching and Learning	Managing and orchestrating the use of digital technologies in teaching and learning
IV. Assessment	Using digital technologies and strategies to enhance assessment
V. Empowering Learners	Using digital technologies to enhance inclusion, personalization and learners' active engagement
VI. Facilitating Learners' Digital Competence	Enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving

Source: European Framework for the Digital Competence of Educators, 2018.

The questions from original questionnaire will be used for composing of different sections of TPACK model (Mishra and Koehler 2006): TK, PK, CK, TPK, TCK, PCK, and TPCK. In the same time the questions could be categorized in four sources of efficacy beliefs: mastery and vicarious experiences; verbal persuasion; emotional and physiological states and imaginal experiences. The categorizing allows to explain teachers motivation for improving their competences including digital skills.

Conclusion

Analyzes of the most known theories and models for the investigation teachers' competences with emphasis on digital skills as well as changes in teachers attitude towards professional development, have shown a wide methodological grounding for further studies in area of teacher training and retraining. The TPACK model is the most appropriate one for creating the studies tool and for the analyzing of the obtained results. These endings can be used as a methodological approach for more accurate conceptualization in upcoming research. The paper may inform future researchers seeking to understand how to conduct the complex research connected with teachers development in TPACK knowledge on the levels of self-efficacy, lesson planning and practical implementation. The challenge for the future steps in conducting of the research is to define modeling experimental target group to be

able disseminate the further study results on the wider teachers' groups through the relevant training courses and recommendations.

References

Ajzen I., (1985), From intentions to actions: A theory of planned behavior. In Action control, Springer Berlin Heidelberg.

Bandura A., (1986), Social Foundations of Thought and Action, Prentice-Hall, Englewood Cliffs, NJ.

Bandura A., (1997), Self-efficacy: the exercise of control, New York: Freeman. https://www.uky.edu/~eushe2/Bandura/BanEncy.html

Bastian J., Riplinger T., (2016), *Tablets for a redefinition of learning? An analysis of video observations to determine the integration of tablets in the classroom*, [In:] Proceedings of EdMedia 2016 – World Conference on Educational Media and Technology, 143–149, Vancouver, BC, Canada, Association for the Advancement of Computing in Education (AACE). Retrieved December 5, 2018, from https://www.learntechlib.org/primary/p/172944/.

Cubeles A., Riu D., (2018), *The effective integration of ICTs in universities: the role of knowledge and academic experience of professors,* Technology, Pedagogy and Education, 1–11.

Davis F.D., (1986), Technology Acceptance Model for Empirically Testing New End-user Information Systems Theory and Results. Doctoral Dissertation. MIT, Cambridge.

Digital Agenda for Europe. Fact Sheets on the European Union. Accessed August 20, 2018. http://www.europarl.europa.eu/factsheets/en/sheet/64/digital-agenda-for-europe

Digital Competence Framework for Educators (DigCompEdu). The European Commission's science and knowledge service. Accessed October 30, 2018. https://ec.europa.eu/jrc/en/digcompedu

European Commission, 2008. Commission Staff Working Document on The use of ICT to support innovation and lifelong learning for all – A report on progress. SEC(2008) 2629 final.

Fishbein M., Ajzen I., (1975), Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research, Addison-Wesley, Reading, MA.

Instefjord E., (2015), *Appropriation of digital competence in teacher education*, Nordic Journal of Digital Literacy, 10, 155–171.

Key Data on Learning and Innovation through ICT at School in Europe 2011. Accessed October 20, 2018. http://eurydice.org.pl/wp-content/uploads/2014/10/129EN.pdf

Korthagen F., Kessels J., (1999), *Linking theory and practice: Changing the pedagogy of teacher education*, Educational Researcher, 28(4), 4–17. doi:10.3102/0013189X028004004

Kurt S., TPACK: Technological Pedagogical Content Knowledge Framework, May 12, 2018 https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/

Landesregierung NRW, (2016), *NRW 4.0: Digitaler Wandel in Nordrhein-Westfalen. Fortschrittsbericht der Landesregierung*. Retrieved November 24, 2018, from https://www.land.nrw/sites/default/files/asset/document/digitaler_wandel_in_nrw_fortschrittsbericht_der_landesregierung.pdf.

Learning and Skills for the Digital Era. The European Commission's science and knowledge service Accessed August 30, 2018. https://ec.europa.eu/jrc/en/research-topic/learning-and-skills

Learnovation Consortium, 2008. ICT, Lifelong Learning and Innovation in e-Training of Teachers and Trainers. [pdf]. Accessed: 01 April, 2011. http://www.elearningeuropa.info/files/lo/teachertraining.pdf.

Mishra P., Koehler M.J., (2006), *Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge*, Teachers College Record, 108(6), 1017–1054. Retrieved November 17, 2019 from https://www.learntechlib.org/p/99246/.

Shulman L., (1986), *Those who understand: Knowledge growth in teaching*, Educational Researcher, 15(2), 4–14.

Shulman L., (1998), *Theory, practice, and the education of professionals*, The Elementary School Journal, 98(5), 511–526. doi:10.1086/esj.1998.98.issue-5

The digitalization of Polish Education Vision and proposals. Accessed October 20, 2018. https://centrumcyfrowe.pl/wp-content/uploads/2016/10/cyfryzacja-polskiej-edukacji_final_EN.pdf

Venkatesh V., Morris M.G., Davis G.B., Davis F.D., (2003), User acceptance of information technology: toward a unified view. MIS Q. 27 (3), 425–478.

Zimmermann F., Melle I., (2019), *Designing a university seminar to professionalize prospective teachers for digitization in chemistry education*, Chemistry Teacher International, Retrieved 19 Nov. 2019, from doi:10.1515/cti-2018-0025

Development and evaluation of methodological measures related to teachers' digital competence

Abstract

The paper presents an analysis of theoretical grounding and methodological issues for working out relevant tool possible for conducting of the complex study of teachers' competences with highlighting on the digital one. This kind of competences is highly required because of the great potential of innovative information and communication technologies regarding teaching and learning. In the 21st century, an effective teacher needs to know how to integrate technology into teaching and to be motivated for the permanent professional development in this case. The article analyzes the most known theories and models for the investigation teachers' competences with emphasis on digital skills as well as changes in teachers attitude towards professional development. Conclusions allow to work out and scientifically justify methodology and research tools for further study issues related to teachers digital competences as a part of their professional development.

Keywords: teachers, theories, competences, digital skills, behavioral changes

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