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# Two (complementary) ways to develop professional digital competences among pre-service teachers

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## Abstract

This article is an attempt to discuss models of digital competence formation among future teachers. Presently, pre-service teachers are a generation that makes intensive use of Internet resources. However, basic ICT skills are not sufficient for effective implementation of new media in their future professional work (didactic and educational areas). This text is a discussion of two models of shaping professional digital competences in the course of academic education. Both models are based on creating knowledge, changing attitudes, as well as building skills that enable adequate, methodically correct and conscious use of ICT as an effective tool in didactic or educational digital environment (full e-learning, blended learning). The text is part of the discussion on the models of digitalisation of education with particular emphasis on the training of pedagogical staff in the intensely developing information society.

## Keywords

Digital competences, didactics, modern teachers, pre-service teachers, ICT in education, curricula, higher education

## 1. Introduction

It is indisputable that digital competence belongs to the group of key competences such as mathematical competence, communication in the mother tongue and foreign language skills and others [1] [2] [3]. Digital competence can be defined primarily as the ability to use information and communication technology (ICT) efficiently, as well as attitudes towards ICT and reflection on the impact of ICT on individual and collective behaviour. Digital competence is the basis for many professions and for functioning in an intensely developing information society [4]. Lack of digital competence brings many challenges in professional and private life [5]. The concern for the proper formation of digital competences is particularly noticeable in education, both from the perspective of learners and teachers [6]. An equally important key group for the sustainable development of the information society are students of pedagogy [7].

Future pedagogical staff are the flywheel for changes in education. Students of pedagogical faculties are a collective that grew up at the stage of intensive development of e-services and at the time of dynamic informatization of the space of social life [8]. On the one hand, students of pedagogical faculties are a group actively using the possibilities of cyberspace mainly in the area of operating websites, entertainment portals, or communication tools (social networks, instant messaging) [9] [10]. On the other hand, the level of digital competence in this group is an area that requires special treatment due to the level of professional digitization, as well as the preparation of professional staff for modern education [11] [12].

Considering the fact that digital competences constitute nowadays an equally important set of skills as the use of analogue didactic aids, there is a particular necessity not only to diagnose the level

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of these skills, but also to try to create optimal academic courses that prepare for effective work in the information society. *The aim of this paper is to show two models of shaping digital competences occurring in universities educating future pedagogical staff.* The article describes both strengths and weaknesses of each of the presented models. The text is the result of an international research project "Teachers of the future in the information society—between risk and opportunity paradigm" funded by the Polish National Agency for Academic Exchange under the Bekker programme" [13].

## 2. Different concepts of digital competence development among future teachers

Digital competences of teachers is a topic that has been systematized in many typologies. These typologies are important for several reasons. Firstly they underline the complexity of the concept of digital competence, which is composed of both hardware and software layers, and issues of reflection on the impact of new media. Secondly the typologies of digital competences show how dynamically the perception of opportunities arising from the use of media in education is changing. Each typology emphasises in a different way the teaching activities mediated by new media, while at the same time highlighting the multifaceted nature of ICT. Thirdly, each new typology of components of digital competence provides an opportunity to discuss the need for in-service teachers and pre-service teachers to improve their digital competence. The analyses conducted so far indicate that many of the typologies are embedded in the diverse cultural, organisational, administrative and financial settings from which the authors come. Table reviews the popular and influential typologies that guide the development of digital competences among teachers, a key professional group for society. Each of the typologies mentioned in Table 1 brings new insights into the complexity of the concept of digital competence. Each of the typologies of teacher digital competence is also an attempt to gain an in-depth understanding of the fields of application of ICT in education and the conditions necessary for the new media to be used effectively.

**Table 1**  
Overview of typologies of teacher digital competence

	Areas	Importance of the framework
TPACK [14]	Three main areas for integration: knowledge, technology, content	Demonstrate the necessity of integrating ICT with a methodical approach
TDC framework [15]	Linking the TPACK theoretical framework to the practical and key activity areas of today's e-service users	To extend the TPACK model to six practical areas related to environmental aspects of ICT, ethics, security, well-being, development, productivity
UNESCO Framework [16]	6 areas of ICT application	To show the possibilities of different degrees of transformation through ICT
ISTE standards [17]	7 areas of application of ICT in different perspectives of teachers' work	To demonstrate not so much specific digital skills as potential areas of application of ICT
ICTE-MM [18]	Possibility of constructing measures to determine digital maturity	The comprehensive approach to digital competence, which requires the consideration of wider contexts (e.g. infrastructure, school specificities)
Digital literacy for	Creation, communication,	Narrowing down the use of ICT

primary teachers [19]	collaboration, digital citizenship, digital identity, e-safety as components of digital competence	by teachers to a particular educational stage
DigiLit Leicester [20]	6 areas of application of ICT at four different levels of advancement	Emphasize the importance of improving digital competences to achieve the highest level
DigCompEdu [21] [22]	Clearly distinguished 6 areas of application of ICT in education (one of the most popular typologies)	Possibility of easy self-evaluation of digital competence. Existence of a closed list of indicators for self-diagnosis.

The brief overview of digital competence presented in Table 1 shows how important and complex this issue is. The authors anchored in different countries try to organise in their own way the fields of application, characteristics, skills, contexts of ICT use in education through their own theoretical frameworks. Each of the presented frameworks (typologies) is valuable in the context of analysis of existing curricula preparing for the teaching profession in the information society. Each typology also makes it possible to modify the content of courses preparing teachers to function in the information society. The question related to the components included in the notion of digital competence is currently a well-saturated issue in the literature belonging to media pedagogy. A question that should still be of interest is how to shape teacher digital competence among students of pedagogical faculties. In other words, what are the currently verified or postulated methodical solutions that allow for quick and effective achievement of the goals in the presented typologies? This key question from the organizational and pedagogical perspective will be answered in the next point. Currently, there is no single universal way to build digital competence based on the aforementioned theoretical frameworks. Therefore, it is necessary to undertake a broader debate on the typologies present in the literature and on the ways in which future teachers develop skills related to the implementation of ICT in educational activities.

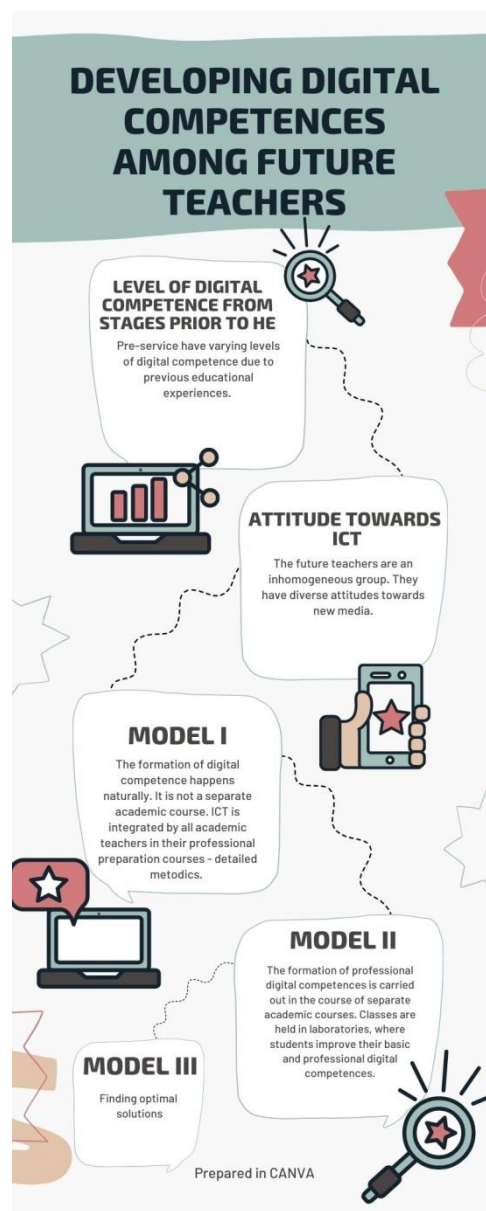
### 3. Two ways of shaping digital competence among pre-service teachers

One of the main roles of a modern university is the preparation of professional human resources. This is a complex task, which requires taking into account many individual and systemic (macro-social) conditions. In the context of educating future teachers in an intensely developing information society, the question arises not only about the set of necessary skills and knowledge (described in the previous section), but also about the way of shaping these skills. The typologies presented above (e.g. in TPACK, DigCompEdu, DigiLit Leicester) form a set of necessary skills, knowledge and attitudes included in digital competence. However, in order to achieve the assumed components of typologies of teacher digital competence, it is necessary to design an appropriate organizational form for the acquisition of these skills. Taking into account the fact that the level of digital competence among future teaching staff varies greatly due to: 1) previous educational experiences - e.g. the quality of IT education at levels prior to university education; 2) individual attitudes towards new media; 3) own experiences (in the role of a learner) related to the use of new media by teachers, as well as 4) the system of organisational conditions of institutions educating pedagogical staff, it becomes reasonable to ask the question of how to shape digital competences of teachers in the higher education (HE) system.

Assuming on the basis of available data that future teachers have different levels of digital competence baseline (defined for example by ECDL standard) [23] [24]. In addition, taking into account that there are many concepts - typologies of necessary knowledge and skills related to the use of ICT there is a need to ask **how to create optimal solutions for the formation of teachers' digital competence?**

Analysing the current preparation curricula for students of pedagogical faculties (pre-service teachers) [25], it is possible to notice the existence of two main organisational forms (models). Both models have the same goal, i.e. to form the ability to efficiently implement ICT in didactic and

upbringing processes. Nevertheless, each of them assumes a different organisational way that leads to this goal. The two discussed models presented in Figure 1 may become complementary to each other or constitute a different path in the training of future pedagogical staff. Both models were deduced through the analysis of the available literature (based mainly on PRISMA) [25]. In addition, the accumulated teaching experience, as well as the research activities carried out so far with experts in the field of media pedagogy from all over the world conducted within the international project "Teachers of the future in the information society-between risk and opportunity paradigm" became the pillars on which the following typology of two (complementary) solutions responsible for the formation of digital teacher competences was built.



**Figure 1:** Developing digital competences - two models

The first model assumes the formation of digital competences in a natural way without the need for specialised academic courses focused on the use of ICT in education. This model involves the formation of teachers' digital competences through the integration of new media during various exercises and lectures conducted by the teachers. The academic lecturers try to show in a frequent manner and as if by the way, different types of educational software that can serve operational purposes. For this solution, ICT is a transparent didactic tool, which is used in an unforced manner and in accordance with the assumed objectives. Of particular importance in the first model is the

inclusion of ICT as one of many didactic means by showing practical applications, especially when discussing assumptions related to specific methodologies. This solution requires extensive digital competence on the part of the instructors, as well as consistency in the training of pedagogical staff for all academic courses. It is also a concept that draws heavily on the idea of BYOD [26] [27]. This model requires consistency in the process of digitalisation of HE, agreement of the authorities of individual institutes on the legitimacy of using a wide range of ICT-based solutions in education, as well as motivation to experiment and improve their own digital competences by all academics.

The second model involves the formation of digital competences for teachers through academic courses attended by students of pedagogical disciplines. Academic courses are taught by researchers - experts in media pedagogy at different levels of advancement and application. Such courses, depending on the specifics of a given university, may include the formation of basic digital competences, e.g. according to the ECDL standard or similar. As part of the introductory course, students learn how basic software works (e.g. office suite, use of e-services, operation of basic IT equipment used in education). The second model also assumes the implementation of additional courses focused on digitally assisted didactics, in which future teachers become familiar with selected educational software used in education, as well as acquire knowledge in understanding the negative mechanisms associated with cyberspace (e.g. prevention of cyberbullying, problematic use of the Internet and other risky behaviours). Activities in the second model based on independent academic courses require having a specialised computer laboratory, where students learn the technical operation of hardware and software (including solutions based on AR, VR, OER, operation of e-learning platforms, software simulating phenomena). The curriculum of the course(s) in this model is not directly linked to the operational objectives of specific methodics (e.g. teaching mother tongue, mathematics, biology, physics and others), but explicitly includes showing the range of ICT applications in different educational contexts. Moreover, such courses ensure the simultaneous generation of knowledge among future educators about the positive as well as negative aspects related to the impact of ICT on the behaviour of children and young people [28].

Both mentioned models of shaping professional - teacher digital competence are characterized by different assumptions concerning the form of achieving efficient use of ICT in the professional context. Both models assume that the modern teacher should integrate ICT in teaching and learning processes. In addition, both models require having the right personnel in the HE system who will be responsible for creating a coherent concept of achieving a sound level of preparation of new pedagogical staff for an increasingly digital education. Table briefly summarises both the strengths and weaknesses of both models.

**Table 2**

Two educational models - strengths and weaknesses

	Model I - no separate academic courses	Model II - specialized academic courses
Strengths of the model	<ul style="list-style-type: none"> <li>+ natural integration of ICT in teaching activities</li> <li>+ flexibility in approach to methods, forms and content for digital competences</li> <li>+ use of BYOD concepts</li> <li>+ stronger involvement of the whole HEI in the process of digitisation of digital institutions among students</li> <li>+ increased overall level of innovation in HE</li> </ul>	<ul style="list-style-type: none"> <li>+ clear course framework (content, time, effects)</li> <li>+ possibility of measuring the increase of digital competence</li> <li>+ delivery by qualified staff (experts in media pedagogy)</li> <li>+ possibility of division into basic and advanced digital competences</li> <li>+ ease of modification of the educational content</li> <li>+ constitution of media pedagogy as an independent sub-discipline</li> </ul>
Weaknesses in the model	<ul style="list-style-type: none"> <li>- the need for full coherence in the digitisation of HE</li> <li>- lack of control over the level of</li> </ul>	<ul style="list-style-type: none"> <li>- the lack of a complete link between digital competence and specific methodics</li> </ul>

growth of digital competences	- the need for modern laboratories
- Lack of clear control over the effectiveness of academic staff in modelling digital learning behaviours	- restriction of intensive digitisation of HE to selected academic courses
- fragmented development of digital competences in the absence of a coherent theoretical framework for a given HE	

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## 4. Conclusions

The two models presented have both strengths and weaknesses related to the development of teachers' digital competence. Minimizing the weaknesses in both solutions is possible by using a mixed mode consisting in: 1) creation of specialist courses related to introduction to information technology (e.g., according to universal standards, such as, for example, ECDL or related), 2) design of independent academic courses related to the methodology of ICT implementation in the teaching process (depending on the teaching specialization), 3) creation of courses on media education (including issues of e-risk prevention), and 4) natural integration of ICT by lecturers teaching general academic or vocational courses. The concept of synergy of the two models appears as an attractive pedagogical idea and is related to the special attention paid to the progressive and irreversible digitalisation of education.

The two models also assume in advance that a given HE institution identifies itself with the necessity of shaping this type of key competence among its own students, which is not fully applicable to all universities, academies dealing with the education of future teachers. The described models are a kind of proposal - an idea, which is based on the resultant concept of techno-optimism and techno-realism [29]. These models are an attempt to show different ways that can become complementary for a methodical and complete transfer of the assumptions of media pedagogy into HE practice. Both models have an overarching goal which is to support learning, teaching and education in the digital age as effectively as possible [30]. This is a task that requires ongoing reflection by HE stakeholders on content and organisational forms that provide effective education for modern schooling.

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