What kind of support for digital competence development do pre-service teachers expect?

Łukasz Tomczyk

lukasz.tomczyk@uj.edu.pl

Institute of Education

Jagiellonian University, Cracow, Poland

Abstract

The aim of this article is to answer the question on what kind of support future teachers expect in order to effectively use new media (information and communication technologies, ICT) in their teaching and educational work. The research is part of the current needs for change in education (including higher education), which are determined by the intensive development of the information society. The research was conducted in 2022 in four Polish universities (three state universities, one private university) educating future pedagogical staff. The survey covered 1002 students, analysing the areas of support they expect in order to use ICT effectively. On the basis of the analysis of qualitative data, 7 categories related to the need for support were identified in the following areas: development of basic digital competences, skills in using e-learning platforms, strengthening knowledge on the use of basic equipment such as interactive whiteboards, increasing awareness and skills in the correct use of educational software, information support on educational software, access to OER, strengthening the LLL process, and improving access to IT infrastructure. The research is linked to the project 'Teachers of the future in the information society - between risk and opportunity paradigms' PPN/BEK/2020/1/00176.

Keywords: pre-service teachers; digital literacy; digital skills; Poland; university; professional preparation; academic courses

Introduction

Educating future pedagogical staff in a dynamic information society is challenging (Walter, 2018; Toto & Limone, 2020). The educational content of academic courses is being transformed. The forms and methods of teacher education are also changing. With each new academic year, new areas emerge that need to be improved in order for future teaching staff to be professionally prepared to carry out teaching tasks also using ICT (Tomczyk & Fedeli, 2022).

Technological determinism is evident in almost every aspect of human life. In the context of the development of the information society, however, it takes on a new meaning (Ziemba, 2019). The

progressive digitalisation is also very clearly discernible in education and is not only due to crisis e-learning (Ptaszek et al., 2020). Teachers are increasingly making use of the potential of new media in achieving their intended teaching goals. ICT has become, at the current stage of development of the information society, a full-fledged didactic means or, in some cases, an educational ecosystem (Martins et al., 2020). Taking into account the above elementary assumptions burdened by many individual, institutional, or systemic conditions, it is worth discussing not only the functioning of current teaching staff in the complex realities of the information society, but also the educational models of future teaching staff.

Considering previous research findings related to the level of digital competence of future pedagogical staff from a number of countries (Walter & Pyżalski, 2022; Neagu, 2022; Linde-Valenzuela et al., 2022; Guillén Gámez et al., 2021), questions arise about the validity of the educational courses chosen. Typically, academic course curricula on digital competence formation are subject to strict institutional regulations that do not always take into account the voice (needs) of all stakeholders. However, academic courses on the use of media in education (most often taught in IT labs) provide a space for modifying and updating educational content in line with contemporary challenges. By definition, these courses should be modified (mainly in terms of content) much more frequently than other classical academic courses, which is due to the specificity of the dynamic development of media pedagogy.

This text attempts to reflect on the need to improve the preparation of future teachers in a rapidly changing information society. Unlike other studies related to the measurement of digital competence among pre-service teachers, the text is focused on the issue of addressing the needs of the younger generation of teaching staff. It fills a gap in this regard and fits into a narrative that aims to modernise education by equipping new teaching staff with the necessary and relevant digital competences. The text is also an attempt to take a critical and constructive look at the overall level of digital competence going beyond simple measurements based on self-evaluation (Tomczyk, 2021).

Research methodology

Aim and subject of the study

The aim of the research is to show the forms of support that are postulated by future teachers and now students on the pedagogy faculty in Poland. The subject of the research was the students' answers to the question - *Can you, as a future teacher/educator, indicate what you need to be able to integrate digital technologies effectively in your future professional activity?* Due to the characteristics of the research question, the research is not only diagnostic, but also useful in terms of the possibility of improving academic courses preparing for the teaching profession.

Research procedure and research paradigm

The research involved 1002 students from Polish universities studying pedagogy. Data was collected in the first half of 2022 via an online survey at the following universities: Nicolaus Copernicus University in Toruń, University WSB in Dąbrowa Górnicza, University of Silesia in

Katowice, Pedagogical University in Kraków.

All responses were subjected to a process of analysis and categorisation according to a qualitative research paradigm embedded in the grounded theory stream (Oktay, 2012; Suddaby, 2006). The choice of grounded theory as a methodological basis was dictated by issues related to the uniqueness of the data collected, as well as considerations related to technological determinism (Dafoe, 2015). It is the phenomenon of technological determinism that makes us realise that the conditions associated with teacher education in a rapidly evolving information society mean that previously acquired knowledge is ephemeral and requires constant revision. Therefore, given the exponential growth of software and hardware used in education, there is a need for continuous reflection on the process of teacher education, taking into account the needs of this group.

The data collected among Polish pre-service teachers was analysed and categorised. The categories presented in the results section have examples of indicators (statements) illustrating the areas identified. Due to the volume of data available, only selected excerpts have been quoted in the description of each category. A diagram of the research process used in this study is presented in Figure 1.

Figure 1 Research procedure
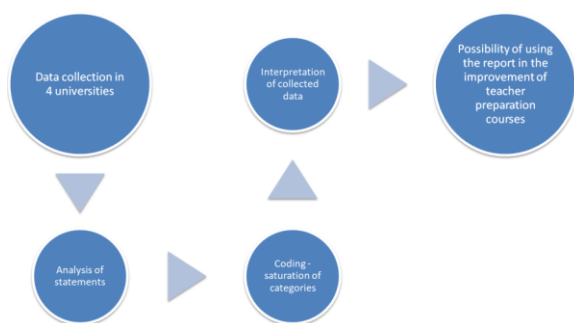
Research ethics

The research was collected as part of the project entitled Teachers of the future in the information society - between risk and opportunity paradigms PPN/BEK/2020/1/00176. The project was funded by the Polish National Agency for Academic Exchange (NAWA). The project was carried out in collaboration with the Italian University of Macerata, where it obtained approval from the Ethics Committee for the collection and analysis of quantitative and qualitative data. The study followed procedures to protect the participants - future teachers - from data protection breaches. The survey instrument was anonymous. Respondents were able to opt out of participating in the online survey at any time (LimeSurvey system). The data collection procedure made it impossible to identify the individuals participating in the study.
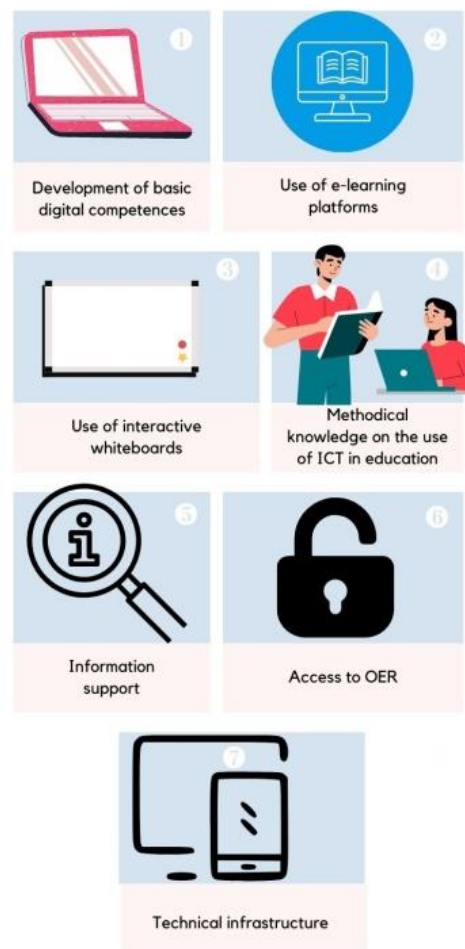
Findings

In the analysis of the responses of prospective teachers, 7 categories emerged that illustrate the needs for effective use of new media in education. Among the categories obtained, issues related to the need to strengthen basic and professional digital competences emerged. In this category, it is noticeable that future teachers expect the university to provide courses that shape the basic digital competences that are necessary for teaching and administrative activities. The second category is related to the need to strengthen skills in the use of e-learning platforms. This category is of particular interest in the context of changes related to the occurrence of crisis e-learning, which has translated into a significant broadening of the indicators defining teachers' professional digital competences. The third category that

emerged from the statements of pedagogical students is related to the use of interactive whiteboards. The fourth category - with the highest number of responses - relates to aspects related to increasing awareness of the possibilities of educational software. This is an area that is becoming crucial in the context of modernising higher education in the area of teacher education. The fifth category relates to support related to access to information about types of educational software. The sixth category is linked to the preceding ones and relates to the process of strengthening digital competences through lifelong learning. The last category is linked to infrastructural factors, i.e. equipping teachers and educational institutions with the necessary IT facilities. All categories are illustrated in diagram number 2 and discussed in detail in the following subsections.

Figure 2 Seven categories extracted from the statements of pre-service teachers

Support for the development of digital litercy among future teachers

Based on qualitative research conducted in Poland (2022), 7 categories of support were identified.

1. Development of basic digital competences
2. Use of e-learning platforms
3. Use of interactive whiteboards
4. Methodical knowledge on the use of ICT in education
5. Information support
6. Access to OER
7. Technical infrastructure

Basic and specialised software

The categorisation of the responses that were collected among Polish students should begin with the emergence of the category of baseline digital competences. These are the basics that make it possible to use ICT freely. Baseline digital competences for future teachers provide freedom of action. Competences of this

type are formed in formal education and in self-education or problem-based learning (self-learning). Baseline digital competences are universal and independent of profession.

As a future teacher, I must above all have the competence to use new technologies freely, so that they do not surprise me and so that I can cope with them.

Have a minimum of IT knowledge, as well as the ability to use a computer efficiently.

Among the basic digital competences, the handling of office software is an emerging component. Although the use of this type of software should have been mastered at a sufficient level much earlier, future teachers point out that there is an area in need of strong support.

Computer courses and courses on how to use basic applications (e.g. Word, PowerPoint) well, to make working in them faster and easier.

In my opinion, training in the basic use of programmes such as Word or Excel, for example, is a good idea, as these are the most commonly used in a teacher's work.

Familiarity with useful programmes, knowledge of Word, PowerPoint, Excel and how to use the technologies in question to produce the desired results.

Among the responses, a group of digital skills also emerges related to the configuration of equipment necessary for professional work and beyond. Students declare the need to know how to connect IT equipment to each other, e.g. for presenting educational content. This need is conditioned by their own experiences, as illustrated by the following statements.

He needs more practical lessons on how to operate, for example, an overhead projector or a computer.

Teachers should be trained more in terms of how to use digital technologies (computer with projector, sound system),

as many of them sometimes would like to use such devices in class, but have problems with installing the equipment and connecting.

Among the components of digital competence necessary for improvement, future students of pedagogical sciences mention various types of specialised software. This is relevant in the context of the division of digital competences into basic-source (universal) competences as well as those related to the operation of specialised software that is required in teaching and educational work.

E.g. programming course, e-journal course, making multimedia presentations. Quizziz, Quizlet, Kahoot, Office suite.

Discord because young people are currently using it extensively.

I would like to learn how to use basic programs like EXCEL etc., which would make my work much easier, in addition to creating websites and advertisements.

Teacher professional digital competence is different from digital skills useful in other professions. It is the handling of hardware and software that supports the achievement of learning objectives. Activities of this type, however, require not only the simple operation of hardware and software, but above all knowledge and experience of linking ICT to teaching processes and integrating new media as intentional means or teaching systems. This theme will be developed in other categories that emerged during the analysis of the interviews.

E-learning

The last two years have been a period of intensive digitalisation of K12 education and university education. This situation is due to the fact that the total educational activity during the pandemic period has been transferred to cyberspace. Assumptions related to ICT-mediated

education have been put into practice due to the need for social isolation. This fact brought many challenges that showed the real level of digital competence of teachers and students related to the use of e-learning platforms. Crisis e-learning proved to be a test of the real-world preparedness to use digital learning resources supported by LMS. However, the following responses from teaching students make it clear that there is a continuous need to improve digital competences related to e-learning.

I need more information about e-learning platforms. It would also be useful to be able to create webinars as there has been a lot of that online recently.

Above all, knowledge of what e-learning platforms exist at all and how to use them.

I think it's very important to have contact with students these days. Covid has shown us that it is fully possible to teach remotely. I think we still need some time to improve this technology of connecting with students and for this we need training and innovative solutions.

Interactive whiteboards

Among the responses, an interesting category emerged related to the use of interactive whiteboards as devices that deserve special attention. Some of the students surveyed point out that these types of devices were not sufficiently discussed in the context of their use in school teaching in university courses. Others add that they learned how to use interactive whiteboards on their own.

The most important element that I would need in my professional activity would be interactive whiteboards, which should be in the classrooms to help with teaching.

I feel that in the subject of media in education there were not enough successful and above all practical

solutions for the practising teacher. And the work with the multimedia whiteboard I had to deal with on my own in my internship at school.

Interactive whiteboard, interactive carpet for creating unusual activities using online resources.

The issue of making full use of interactive whiteboards continues to be a challenge not only for university education, but also for K12. Interactive whiteboards and related devices (e.g. interactive carpets, VR, AR, 3D printers) are not just attractive gadgets but full-fledged and effective teaching aids that should be used by graduate pedagogues.

Increase awareness of the potential use of educational software

A key component of teacher digital competence is the ability to apply ICT in specific educational settings and contexts. Merely being able to use software and hardware proves to be insufficient in the sector under analysis. In the context of being an effective teacher, pre-service teacher students perceive several gaps that need to be filled during their university preparation. Among the postulated changes for pre-service teachers, they mention issues related to knowledge of the entire range of software, as well as the ability to implement them methodically.

We need more awareness about different programs, apps for learning. Because I only know the basic ones, and most of the programs that were mentioned in this survey are alien to me.

Courses and training in topics: which platforms and apps are good, how to use them, how to make classes more interesting.

I would like to learn about programmes that will allow and help me to make my teaching activities more attractive.

Respondents also point out that the current form of preparation for the teaching profession in the information society does not provide some of the students with the skills to implement new media in specific pedagogical activities. Students lack the connection between the application of their digital competences and the implementation of specific activities within formal education. The praxeological dimension is an activity very often indicated by those interviewed.

I need training and classes on - not only a demonstration of the technologies I can use but also their practical application, e.g. in the form of a whole demonstration lesson.

Concrete examples of use, lesson plans - based not only and exclusively on computer work, but using these technologies as tools for pedagogical work.

More practical exercises in this area (there is far too little of this at university).

The previous statements are reinforced by the voices of selected students, who emphasise very strongly that the responsibility for adequately preparing future teachers to function in the information society lies solely with university staff. Too much theorising about media pedagogy does not lead to the formation of real skills that are useful after graduation.

I should be able to see my professors or placement tutors actively using digital technology, not just telling me how important it is in a child's education. By listening, I won't learn how to use them- only eyewitnesses showing me how they work and how to use them will make it easier for me to use them in the future.

I need more college classes to prepare me for working in the digital world. I need content preparation in this subject and more practice hours in programming, media work, etc.

In this category, a subgroup emerges that clearly suggests that their digital competences are at an insufficient level. Those selected emphasise that they have not dealt with the issues analysed (mainly students at the initial stage of their studies) and therefore if hypothetically they had to implement ICT at this stage it would be a great problem for them, create discomfort and raise issues of methodological correctness.

I am a person who is not very volatile when it comes to using digital technology, so I would expect to be introduced to various technologies etc. before my job so that I don't have to stress before classes with children that I won't know how to do something and the whole class will be in ruins.

Above all, I would personally feel the need for training on this topic. During my studies, this is a topic that is not touched upon. I myself do not feel so secure in this topic to introduce digital technologies in my future professional activity. It would be a daunting task to explore a world that is very complex and deep for children. You need knowledge, skills to do that. No one would want to harm a child with a lack of knowledge.

The presented category provides a certain baseline for the whole article - the research results. Simple digital competences or complex teacher digital competences should be validated in academic courses as well as tested in student placements. In this case, ICT is a teaching resource that should be skilfully implemented - just like other analogue solutions that support the improvement of educational quality or the achievement of learning goals.

Guided resources

Respondents point out that a system of tutorials in the form of audiovisual material could be a great help for this group. A collection of resources with instructions would constitute a repository for the development of digital competence through self-learning. Given the speed of development of the information society, such repositories fill a gap that commercial teacher training or hour-limited academic classes are unable to address.

I need to improve my knowledge of and familiarity with the tools available (e.g. through tutorials, instructions in Polish, tutorials).

More instructional videos and information on where I can find the app and what it is used for. That way there would be no tedious and overly long search for them on the Internet.

I would need a short instructional video on how to use the technology, what functions it has, what can be achieved based on the technology.

Future teachers point out that it would be useful to have access to a set of information on particular educational software. Such a list should be publicly available, prepared by experts (checked in terms of methodological correctness and functionality). It also seems reasonable to make the list available on official websites supervised by school boards or institutions dealing with teacher support. The list should also be updated on an ongoing basis.

I need a proven database of the best apps (so that I don't have to dig through millions of adverts and check each one individually to see that it doesn't work).

Above all, knowledge of them [e.g. the list on the Board of Trustees website], also accessible tutorials. It would be eminently helpful if these apps were free, or with a special licence for education.

A collection containing instructions for the use of various applications, so that any teacher could use it and easily learn how to use it.

An inventory of all applications, programmes and platforms (where new ones coming onto the market will be added continuously) and their evaluation, comparison with each other.

Instructional resources are a very specific demand that should be part of the support of pre-service teachers and in-service teachers. It is an activity that falls into the area of not only the activities of chairs, institutes or other organisational units that study the use of media in education, but also of method centres or school boards. From the information currently available, these institutions are increasingly building such repositories, but knowledge about them is still not properly disseminated among students of pedagogy.

Free software and educational resources (OER)

The Internet offers many opportunities, but some of the resources and websites with high teaching effectiveness are limited by the licence fees associated with use. Regardless of whether the website will be used for non-commercial purposes (K12 education) or commercial purposes (e.g. adult training), selected websites require one-time use or subscription fees. For this reason, future teachers pay attention to preparing them in the use of open educational resources (OER). Such an action is crucial in a situation of limited financial resources for the entire educational ecosystem.

Internet, a tablet and access to programmes without having to purchase an additional subscription. A tablet on which the teacher sits to write the content displayed on the electronic whiteboard for the students would also be useful.

I use Canva most of the time. I miss the place on the web where there are free graphics.

Familiarity with available digital sources in order to be able to adapt them to the needs and abilities of young people.

Often interesting applications and technologies require the purchase of a licence.

The statements quoted above are also crucial in the situation of non-infringement of copyright and property rights of creators of educational software or audiovisual resources. Support through adequate preparation requires the inclusion of digital competence formation as a construct that not only builds skills in the use of the software in question, but also shapes knowledge of intellectual property protection law while exploiting the potential of the OER concept.

Basic working environment - ICT equipment

There is also a group of statements indicating that support in the development of digital competences is in relation to the provision of a proper IT infrastructure. The surveyed future teachers point out that the equipment that is in educational institutions does not meet the requirements of modernity. The ICT that some schools are equipped with does not meet the requirements for effective use. Respondents point out that without the right equipment there is no possibility to use the chosen software. Inoperable IT equipment, outdated IT equipment or an insufficient number of computers in schools is a systemic

problem that prevents the ideas found in media pedagogy from being put into practice.

So what if I can plan cool activities if there's no way to implement them. I'm not talking about presentations, because there are already too many of those, but about being able to work in different programmes, and for that you need good equipment.

Above all, it needs efficient state-of-the-art equipment to carry out digital activities, for example.

I think I definitely need the right equipment in the workplace, as well as support from my superiors, commitment, willingness and a modern approach.
I think that also the curriculum should provide for the inclusion of such elements in the educational process.

First and foremost, it is important to equip the facility so that the teacher does not have to supply digital technology out of his or her own pocket.

Definitely good equipment. Currently, many schools and kindergartens have outdated equipment that is slow to operate and often even prevents them from undertaking certain activities.

I think that Polish schools and kindergartens above all lack these devices. It is difficult to conduct lessons effectively if, for example, there are three pupils sitting at one computer....

My kindergarten has an interactive touchscreen TV with internet access, you can open a Google browser, use apps successfully. The only thing that is a hindrance is that it is located in the gymnasium, there is one for 5 groups, or 125 children. A minimum of an overhead projector would be useful in each room in order to take full advantage of the resources that the new technologies offer us.

Future educators also pay attention to the quality of Internet connections in schools. Taking into account that the Internet is not available everywhere without restrictions and that the Internet is not always of good quality, this type of postulate seems worth taking into account the stage of development of the society at which education should be located. The respondents also point out issues related to access to the now elementary software allowing to share files, carry out tasks at a distance.

Above all, we need a good, strong Wifi connection, (so that the internet does not jam when presenting online). In addition, it is worth thinking about business accounts, e.g. Microsoft package, disk capacity on Google, purchased materials in Canva, Wordwall (in this way, the teacher would have access to varied graphics, opportunities to present knowledge).

Without a printer and a computer, it is now difficult to talk about a teacher's job or an overhead projector.

Analysing the statements, another group of answers also emerges, which does not constitute one logical compact category. In this cluster of diverse statements, it can be seen that there is a group of future teachers who do not need any support for the development of digital competence. Also in this group there are indications that what is currently available on the market is completely sufficient. Examples of uncategorised statements showing a completely different perspective to the previously mentioned categories can be found below.

I don't need any support - my current skills are sufficient.

I believe that Teams or Zoom are sufficient

I think it just takes a little imagination. Nowadays at every level of education you can easily incorporate digital technologies in an effective way.

Above all, I need the director, who would look after the establishment where I would be working, to look favourably on digital technologies and be willing to fund them himself in order to be able to supply the establishment with the appropriate modern teaching resources. If there were no objections from the directorate, I would like to see some workshops for the teaching staff on how to use these resources and how to integrate their potential into their work with children.

Probably nothing, all the time using digital technologies to help assimilate knowledge

Discussion and conclusion

This text is part of the discussion on the modernisation of higher education in pedagogical training. The data collected is limited to one country from Central and Eastern Europe, resulting in categories that are not representative in a global perspective. Nevertheless, the article tries to fill the gap and show a certain set of universal challenges faced by pre-service teachers in an intensely developing information society. The text also attempts to draw attention to the disharmony that exists between individual perspectives and institutional conceptions of teacher education. The qualitative perspective does not show the scale of support necessary for the individual categories, but is a phenomenological attempt to understand areas that are not always clearly perceived by university teachers teaching academic courses related to the formation of digital competences among young students of pedagogical sciences. It therefore seems

reasonable and interesting to carry out further research in the trend of quantitative studies showing the scale of needs in the above-mentioned areas while taking into account the sociodemographic characteristics of the respondents.

However, the seven main categories presented show some important elements that should now be given more attention in order to train adequately prepared pedagogical staff. Within the first category, students referred in different ways to their own level of digital competence. In the group of young people who have grown up in the natural "company" of ICT, there are indications that their digital competences related to the use of basic and advanced software are not sufficient, and therefore the university (as part of academic courses) should provide educational support. This postulate is in line with the observations of other researchers, who highlight that digital competences in the group of future teachers are highly variable (Cruz & Díaz, 2016; Eger et al., 2018; Siddiq & Scherer, 2019; Jackman, 2021) and not all young people are characterised by a high level of ICT skills, which are often limited to the use of entertainment and communication services (Pyżalski et al., 2019; Tomczyk, 2021).

Prospective teachers also point out that they are not adequately prepared to use e-learning platforms. This situation is linked to the experiences they have accumulated by taking on the role of learner in the last several months. However, the problem of methodical use of e-learning platforms is not a shortcoming to be solved only among future teaching staff, but also a phenomenon occurring among active teachers (Kulikowski et al., 2022; Maatuk et al., 2022).

According to respondents, their knowledge and skills are also limited when it comes to operating and configuring basic IT equipment. Here, respondents highlighted simple activities related to connecting devices, displaying digital material. They built their statements based on a comparison of their own skills with the activities that in-service teachers currently perform (or sometimes fail to perform). This is an important indication because, as the data collected shows, how teachers use and solve ICT configuration problems builds an image among learners of them as competent educators (EL JANOUS, 2022; Deshmukh et al. , 2022).

An important category that emerged from the analyses is professional teacher digital competence. Statements from future teachers emphasising the need to combine their ICT knowledge and skills with methodological aspects are evident among all stakeholders in the process in question (Tondeur et al., 2016; Stosic et al. 2020; Kasperski et al., 2022). The integration of digital competences together with methodological knowledge is an important element in professional preparation. Therefore, when modifying the curriculum, it is necessary to take into account and develop solutions that not only strengthen the overall level of digital competence, but also the ability to use software and hardware consciously and efficiently.

Two of the categories that emerged addressed the issue of self-learning in the area of digital skills development. The category of self-learning in the use of educational software is a phenomenon recognised in the media pedagogy literature (Tomczyk & Potyrała, 2021). Self-learning appears here as a necessary phenomenon in a situation of exponential growth of educational software. An

equally important element mentioned by students was the indication of access to open repositories with digital educational resources. Software lists, prepared tutorials and other resources with access to guides for the methodical use of ICT in education is a component supporting the development of professional digital competences.

Among the elements that significantly support and enable the use of ICT in education is the IT infrastructure. Without proper infrastructure, digital competences are a theoretical resource that does not allow the potential of the information society to be properly exploited. Indications of the future generation of teachers also show that certain phenomena occurring e.g. two decades back are still taking place (Tomczyk et al. 2019; Cheshmehzangi et al., 2022; Ruecker, 2022). Therefore, the phenomenon of digital exclusion - in the form of an infrastructural factor - should be considered in the first instance when measures are taken to modernise and digitise didactics at each level.

This text does not pretend to be an exhaustive list of indicators demonstrating the digital competence development needs of pre-service teachers. It should be seen as a contribution to the discussion on the need for permanent change due to technological determinism. The study is limited in geographical scope, but the indications listed in the text may be universal and have global relevance to situations in other countries. The categories identified may not only become an inspiration for the modification of the system of educating future teachers, but may also become in the near future clearly distinguishable research areas in pedagogy subject to longitudinal diagnostic activities.

References

Cheshmehzangi, A., Zou, T., Su, Z., & Tang, T. (2022). The growing digital divide in education among primary and secondary children during the COVID-19 pandemic: An overview of social exclusion and education equality issues. *Journal of Human Behavior in the Social Environment*, 1-16.

Cruz, F. J. F., & Díaz, M. J. F. (2016). Generation z's teachers and their digital skills. *Comunicar. Media Education Research Journal*, 24(1).

Dafoe, A. (2015). On technological determinism: A typology, scope conditions, and a mechanism. *Science, Technology, & Human Values*, 40(6), 1047-1076.

Deshmukh, A. R., Raghava, V., Kumar, R., & Aggarwal, M. (2022). Smart Classes Teaching Using Advanced Techniques for Quality Education. *Journal of Positive School Psychology*, 1923-1929.

Eger, L., Klement, M., Pisoňová, M., & Petrová, G. (2018). Different user groups of university students and their ict competence: evidence from three countries in central Europe. *Journal of Baltic Science Education*, 17(5), 851.

EL JANOUS, Y. (2022). Teachers and students perceptions of the causes of school failure: an empirical study. *Revue

Marocaine de l'Évaluation et de la Recherche Educative, 7(7), 550-562.

Guillén Gámez, F. D., Ruiz Palmero, J., Palacios Rodríguez, A. D. P., & Martín Párraga, L. (2021). Formación del profesorado universitario en competencia digital: análisis con métodos de investigación correlacionales y comparativos. *Hachetetepé. Revista científica de Educación y Comunicación*, 24.

Jackman, J. A., Gentile, D. A., Cho, N. J., & Park, Y. (2021). Addressing the digital skills gap for future education. *Nature Human Behaviour*, 5(5), 542-545.

Kasperski, R., Blau, I., & Ben-Yehudah, G. (2022). Teaching digital literacy: are teachers' perspectives consistent with actual pedagogy?. *Technology, Pedagogy and Education*, 1-21.

Kulikowski, K., Przytuła, S., & Sułkowski, Ł. (2022). E-learning? Never again! On the unintended consequences of COVID-19 forced e-learning on academic teacher motivational job characteristics. *Higher Education Quarterly*, 76(1), 174-189.

Linde-Valenzuela, T., Guillén-Gámez, F. D., & Devitt, A. (2022). Digital Literacy of Teachers, Families, and Students for Virtual Participation in School: A Multiple Comparison Analysis. *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, 17(1), 1-8.

Maatuk, A. M., Elberkawi, E. K., Aljawarneh, S., Rashaideh, H., & Alharbi, H. (2022). The COVID-19 pandemic and E-learning: challenges and opportunities from the perspective of students and instructors. *Journal of Computing in Higher Education*, 34(1), 21-38.

Martins, V. F., Tomczyk, Ł., Amato, C., Eliseo, M. A., Oyelere, S. S., Akyar, Ö. Y., ... & Silveira, I. F. (2020, July). A Smart Ecosystem for Learning and Inclusion: An Architectural Overview. In *International Conference on Computational Science and Its Applications* (pp. 601-616). Springer, Cham.

Neagu, G. (2022). Understanding the Implications of Digital Competence for the Education Process in Romania. A Literature Review. *Lecture Notes in Educational Technology*, 441–462. doi:10.1007/978-981-19-1738-7_21

Oktay, J. S. (2012). *Grounded theory*. Oxford: Oxford University Press.

Potyrała, K., & Tomczyk, Ł. (2021). Teachers in the lifelong learning process: examples of digital literacy. *Journal of Education for Teaching*, 47(2), 255-273.

Ptaszek, G., Stunża, G. D., Pyżalski, J., Dębski, M., & Bigaj, M. (2020). *Edukacja zdalna: co stało się z uczniami, ich rodzicami i nauczycielami*. Gdańsk: Gdańskie Wydawnictwo Psychologiczne Sp. z oo.

Pyżalski, J., Zdrodowska, A., Tomczyk, Ł., & Abramczuk, K. (2019). *Polskie badanie EU Kids Online 2018*. Najważniejsze wyniki i wnioski. Poznań: UAM.

Ruecker, T. (2022). Digital divides in access and use in literacy instruction in rural high schools. *Computers and Composition*, 64, 102709.

Siddiq, F., & Scherer, R. (2019). Is there a gender gap? A meta-analysis of the gender differences in students' ICT literacy. *Educational research review*, 27, 205-217.

Stosic, L., Dermendzhieva, S., & Tomczyk, L. (2020). Information and communication technologies as a source

of education. *World Journal on Educational Technology: Current Issues*, 12(2), 128-135.

Suddaby, R. (2006). From the editors: What grounded theory is not. *Academy of management journal*, 49(4), 633-642.

Tomczyk, Ł. (2021). Declared and real level of digital skills of future teaching staff. *Education Sciences*, 11(10), 619.

Tomczyk, Ł., & Fedeli, L. (Eds.). (2022). Digital Literacy for Teachers. *Lecture Notes in Educational Technology*. doi:10.1007/978-981-19-1738-7

Tomczyk, Ł., Eliseo, M. A., Costas, V., Sánchez, G., Silveira, I. F., Barros, M. J., ... & Oyelere, S. S. (2019, June). Digital Divide in Latin America and Europe: Main characteristics in selected countries. In *2019 14th Iberian Conference on Information Systems and Technologies (CISTI)* (pp. 1-6). IEEE.

Tondeur, J., van Braak, J., Siddiq, F., & Scherer, R. (2016). Time for a new approach to prepare future teachers for

educational technology use: Its meaning and measurement. *Computers & Education*, 94, 134-150.

Toto, G. A., & Limone, P. (2020). Hybrid digital learning environments for college student education. In *Second Symposium on Psychology-Based Technologies Psychology-Based Technologies PSYCHOBIT 2020* (pp. 1-8). ceur.

Walter, N. (2018). Współczesne wyzwania pedagogiki i edukacji medialnej. *Neodidagmata*, (36/37), 41-50.

Walter, N., & Pyżalski, J. (2022). Lessons Learned from COVID-19 Emergency Remote Education. Adaptation to Crisis Distance Education of Teachers by Developing New or Modified Digital Competences. *Lecture Notes in Educational Technology*, 7–23. doi:10.1007/978-981-19-1738-7_2

Ziemba, E. (2019). The contribution of ICT adoption to the sustainable information society. *Journal of Computer Information Systems*, 59(2), 116-126.