

Factors Influencing Digital Competence of Pre-Service Teachers: A Systematic Review of Literature

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Abstract

Technology has become an integrated part of today's education system. It has become the need of present times that the teachers must easily use, create, and adapt to the technological environment. This literature review aimed to identify factors that influence the digital competence of pre-service teachers. The study has been conducted by reviewing empirical findings, which are focused on the utilisation of digital tools in teaching pre-service teachers. The databases of SpringerLink, JSTOR, Education Resource Information Center (ERIC), Google scholar were accessed. Results of analyses revealed that attitude & self-efficacy, required skills & knowledge, practical experiences of using technology and access to technology are the factors that majorly influence pre-service teachers' digital competence. Based on the reviews, the suggestions are provided for education policymakers, stakeholders and Teacher Education Institutes (TEIs) to further improve teacher education programmes and focus on technology-integrated teaching practice to help pre-service teachers in becoming comfortable with digital equipment.

Keywords: Digital Competence, ICT, Pre-service teachers, Technology, Teacher Education

Introduction

Technology integration into the education system has now become a key focus for educators. The use of technology has become a necessity to survive in our day-to-day life. In all the leading sectors such as health, education, real eState, automobiles, banking, etc. technology is playing a major role in transforming their functioning and becoming an essential component in all the sectors. In the education sector, the use of digital equipment and newly emergent technology is rapidly increasing. In the times of pandemic, the discontinuation of face-to-face lectures and the increased dependence on online teaching brought revolutionized changes in the new

educational setup (Hew, 2020). This sudden transformation raised many questions on the preparation, skills and beliefs of teachers on accepting and integrating technology in their curriculum delivery (Chang, 2020). In such times, when ICT is changing the face of the education sector then the teachers must be prepared to fulfil the needs of technology-integrated learning opportunities in classrooms. Many world level organisations recognised the need for teachers to be highly competent in the field of Information and Communication Technology. These organisations predicted that soon technology will dominate its role in the field of education, thus they prepared essential competency frameworks in

the field of educational technology to prepare our teachers with skills of incorporating technology effectively into the classrooms.

UNESCO ICT-CFT Framework

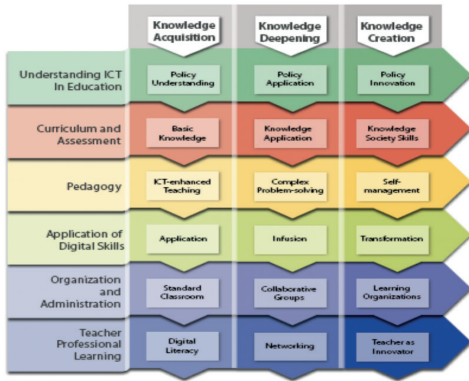
In 2008, UNESCO had developed the first version of its Information and Communication Tools Competency Framework for Teachers (ICT-CFT), which highlighted the ICT competencies for pre-service and in-service teachers to be acquired by them across the nations to advance the teaching-learning process. Till 2018, UNESCO had publicized a total of three versions of ICT-CFT Framework. In previous versions of the ICT-CFT three levels of teacher development namely, Technology Literacy, Knowledge Deepening and Knowledge Creation and six different focus areas of teachers’ professional practice, such as Understanding ICT In Education, Curriculum and Assessment, Pedagogy, ICT, Organisation and Administration and Teacher professional Learning were arranged in such order that the teachers not only become skilled in using ICT but also teach and solve the real-time ICT problems encounter by them in the classrooms. In the third version of ICT-CFT among the three different teacher development level, the area ‘Technology Literacy’ was re-modified to ‘Knowledge

Acquisition’ and the earlier key aspect named ‘ICT’ was modified to ‘Application of Digital Skills’.

In total, 18 ICT competencies were given a place in this framework which is focused on the holistic development of teachers in the field of Information and Communication Technology (ICT). In this framework, as shown in Image1, teachers are required to possess a basic knowledge about policy perspectives involved in ICT in Education, ICT-enhanced pedagogy, knowledge and application of digital skills, classroom management, and digital literacy in the first level. The second level of teacher development focuses on deepening knowledge, where the teachers are required to learn skills of facilitating the learning environment with the use of technology and making it student-centric. Teachers are required to display and connect their ICT skills to fulfil classroom requirements.

The third level of the ICT-CFT framework requires teachers to innovate, create and manage their pedagogies in such a way that they can transform the learning environment for students. The framework seeks teachers to make technology integrated classrooms to set an example and inspire others to achieve the desired outcomes.

Figure-1: UNESCO ICT-CFT Framework



Version 3.0

Source: en.unesco.org

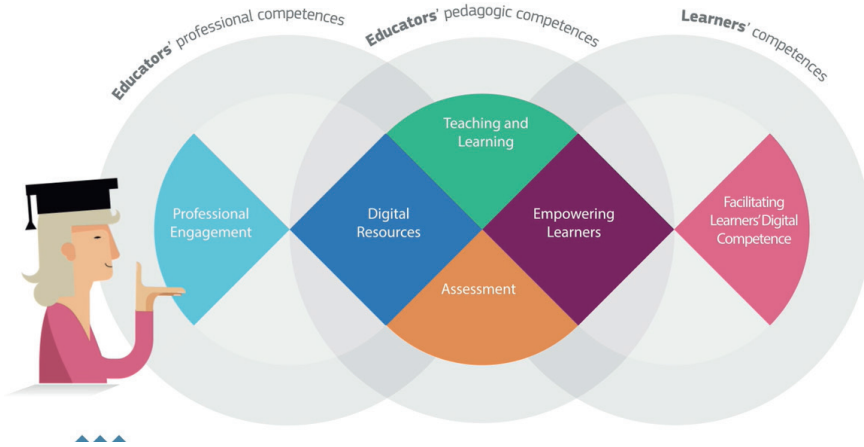
The ICT-CFT is aimed towards the crucial role of technologically competent teachers that can help students in becoming creative learners and effective citizens. The teachers nowadays are required to be more efficient in integrating technology into the classroom and provide new pedagogical practices that will transform the education sector. (UNESCO, 2013).

Digital Competence for Education (DIGCompEdu) Framework

The European Union had developed a Digital Competence (DigComp) Framework for EU citizens. According to reports, in 2015, 44.5 percent of the EU population had shown insufficient digital skills and there was also a sufficient increase in the number of cyberbullying

cases among the young population of Europe. The Digital Competence framework (DigComp) was aimed at educating and improving the digital skills of the citizens of Europe (Vuorikari. Et.al, 2016). The DigComp framework was divided into five areas: Information and data literacy, communication and collaboration; Digital content Creation: Safety and Problem-solving. In the year 2017, the European Union publicized its education-specific Digital Competence for Education Framework (DigCompEdu). Its main focus is on developing professional, pedagogic and Learner related competencies among teachers. It does not concentrate on core technical skills, but rather developing digital skills to ensure effective technological usage and making a better learning environment.

Figure-2: DIGCompEdu Framework



Source: ec.europa.eu

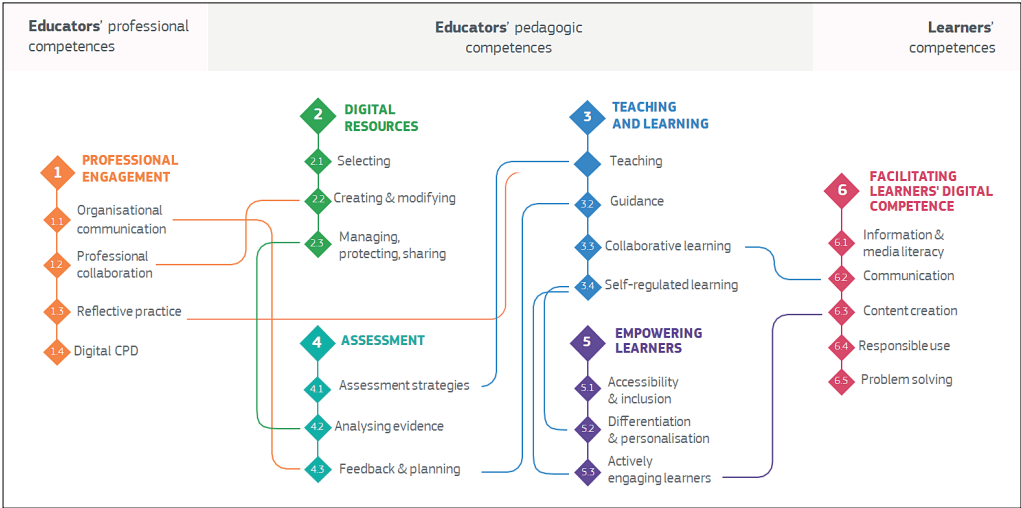
According to Redecker (2017), the DigCompEdu framework consists of 22 teacher-specific competencies which are organised in six areas such as “professional engagement, Digital resources, teaching and learning, assessment, empowering learners and facilitating learner’s digital competence”. These professional competencies are designed in a way that major

professional requirements as identified by the framework i.e., organisational communication, professional collaboration, reflective practice and digital Continuous Professional Development can be attained using digital toolseffectively.Italsoemphasises on achieving pedagogic competencies such as selection, creation, managing, protecting and sharing digital resources;

to innovate assessment strategies using digital resources; to plan the digital technologies enriched lessons and using them for collaborative and self-regulated learning; to ensure the availability of digital resources to address diverse learner needs; to make sure that every learner is actively participating in learning. It gives importance to teachers' role in educating the learners

about the reliable ways of finding information on digital networks; to communicate responsibly using digital networks; to create digital content considering ethical ways of using digital information; to avoid risks involved in the digital world and maintaining social and emotional well-being and to convert their technological knowledge while addressing new situations.

Figure-3: Teacher-Specific competencies as per DIGCompEdu Framework



Source: ec.europa.eu

It's a requirement of this time that the training of student teachers should be done in this way so that they can meet the needs of digital natives and facilitate their needs by using effective digital resources. (Mishra and Koehler, 2006). The digital competence in education can help in fostering various innovative ideas among teachers to incorporate digital tools and facilitate learning. The various factors among the pre-service teachers such as lack of experience, attitude, beliefs, lack of accessibility, etc. hinder their digital competence. (An, Y., 2018; Yerdelen-Damar, 2017; Cak, 2017)

Methodology

The logic behind the search of the literature was to find the major factors

that influence the digital competence of pre-service teachers. The databases of SpringerLink, JSTOR and Education Resource Information Center (ERIC) were searched. Few limitations, to assure the quality of the research, were decided in advance, which are as follows:

1. It was published in peer-reviewed journals only.
2. It was written in the English Language only.
3. It was available with full- text.
4. It included pre-service teachers only.
5. It was empirical research.

The following terms: 'Digital competence' and 'pre-service teachers' or 'teacher trainees' or 'teacher education' or 'ICT Competence' and a combination of such terms were used to get desired search results. In total, 1036 search results were generated. Initially, the search results were delimited based

on title, abstract and keywords. After removing duplicate studies, a total of 90 search results were selected for further analysis. After reviewing full paper analysis, a total of 21 studies given in Table 1 were selected to make the source of the present article.

Table-1: Selected studies on pre-service teachers' digital competency (n=21)

Author	Method	Data Sources
Altun, D. (2019).	Correlational research design	Cross-sectional Survey
An, Y. (2018)	Mixed method	Pre-test Post-test design
Barak, M. (2014)	Mixed Method	Five-point Likert Scale; reflective drawing analysis framework;
Çak, Ü., Universtiy, K. T., & Göko, S. (2017)	Quantitative method	Likert scale
Çebi, A., & Reisoglu, I. (2020)	Cross sectional Survey	Questionnaire
Cığerci, F. M. (2020)	Explanatory Sequential design: Mixed method	Pre-test post-test design; Interviews
Demirkan, Ö. (2019).	Phenomenological Design	Written form for pre service teachers' views
Dorner, H., & Kumar, S. (2016)	Online collaborative Mentoring Approach	Questionnaire; mentoring intervention
Efe, R. (2011)	Quantitative method	Questionnaire
Erbakan, N., Acceptance, T., Situations, U., Pedagogic, W., Knowledge, C., Variations, D., & View, T. (2015)	Quantitative method	Digital Competence Scale
Goktas, Y., Yildirim, Z., & Yildirim, S. (2008)	Quantitative and Qualitative methods	Questionnaires; Semi-structured interviews
Gordillo, A., López-Pernas, S., & Barra, E. (2019).	Mixed method	Questionnaire; Pre-test post-test design; LORI instrument
Hong, A. H., & Sullivan, F. R. (2013)	Mixed method research design	Survey data; Phenomenological study; Interviews

Ju, Y., Park, S., & Lim, E. (2018)	Quantitative	Five-point Likert Scale
Kimmons, R., Miller, B. G., Amador, J., Desjardins, C. D., & Hall, C. (2015)	Mixed method	Pre-test and post-test survey; Self-assessed technology competence and written reflections
Korucu, A. T., Yücel, A., Gündoğdu, M. M., & Gençtürk, T. (2016)	Quantitative	Digital competence scale
Lin, T., Tsai, C., Chai, C., & Lee, M. (2013)	Quantitative	Survey data
Mccullagh, J. F., & Doherty, A. (2018)	Mixed Method	Questionnaire; Interviews
Sancar-Tokmak, H., Surmeli, H., & Ozgelen, S. (2014)	Case study method	Interviews; observation and open-ended questionnaire
Yerdelen-Damar, S., Boz, Y., & Aydın-Günbatır, S. (2017)	Quantitative	Self-efficacy scale
Yiğit, E. Ö. (2020).	Interpretative Phenomenological Analysis	Open-ended questionnaire; content analysis; interviews

Findings

The reviews covered the studies that were focused on the integration of digital technologies in pre-service teacher education programmes. In the reviews, data was collected through quantitative, qualitative and mixed-method research methodologies. The quantitative analysis of studies constructed 38.09 percent of the source of information, whereas the remaining 61.91 percent of data in selected studies were collected from qualitative and mixed-method research design.

After analysing the studies, the main factors identified below:

Reviews

Attitude and Self-Efficacy

TPACK competencies are directly associated with the pre-service teachers' attitude towards technology. The daily

usage of social media and playing games on smartphones does not reveal that the teachers' will use these technologies for their professional development. Altun, D. (2019) suggested including practical experience of digital tools in pre-service teacher education programmes to increase awareness regarding the integration of digital tools in teaching. The online professional development courses brought changes in the perception of pre-service teachers towards integrating digital games as an effective learning tool, whereas it was also measured that there has been a positive development in an attitude of pre-service teachers (An, Y., 2018). The confidence in using digital tools plays a big role in adopting technology and making a positive attitude towards technology (Barak, M., 2014). Hong, (2013) used a five-point Likert scale questionnaire to measure the readiness of pre-service teachers for technology integration which predicted

that prior teaching experience and the student teaching experience at different grade levels from elementary level to secondary level impacts on the readiness of pre-service teachers. Sancar, et, al. (2014) found that the pre-service teachers show various misbeliefs regarding their technological skills in their initial teacher education programme. When they face real time scenarios in solving digital problems then they lack sufficient knowledge. Yerdelen-Damar (2017) found that the higher the pre-service teachers' skills and experience of using technology, the higher will be their self-efficacy. Improving TPACK by various workshops and training programmes at teacher education institutes will bring positive effects on the pre-service teachers' self-efficacy. This will also prepare teachers to accept technology as an integral part of the classroom. (Ju, 2018)

Practical experience of using technology

The experience of teachers with technology plays an important role in determining their competence in using technology in the classroom (Cak, 2017). The online professional development courses that provide hands-on experiences to pre-service teachers were found to be more effective in making them comfortable with the use of technology (An, Y., 2018). In another study, a positive relation was found between the pre-service teachers' previous experience of using technology and their familiarity regarding technological tools with their digital competence level (Efe, 2011). Prospective teachers are more inclined to get practical knowledge of ICT resources rather than just theoretical knowledge. The more they get exposure to the practical experiences, the more their confidence will increase (Goktas, 2008).

Dorner, (2016) conducted a study on

implementing a Mentoring Innovation Model by combining the knowledge and expertise of technology mentors with the teaching practices of pre-service teachers. The online interaction and collaboration with mentors helped in understanding the practical ways of integrating technology in the classrooms and brought more confidence in pre-service teachers. As of Dorner, when pre-service teachers were allowed to collaborate with in-service teachers to use technology in their lesson plans they had shown high confidence in comfortably using technologies for classroom teaching. Findings from a study in which the experiences of pre-service teachers were recorded while using a web-based video analysis tool Video Ant Stated that the pre-service teachers enjoy using such tools and it also helps in enhancing their confidence in teaching while using technology (Mccullagh, 2018).

Required Skills & Knowledge

The pre-service teachers show very less digital competence in knowledge of identifying digital tools and skills required in developing digital content than in other areas of digital competence viz. information and data literacy, communication and collaboration and safety (Çebi, A., & Reisoglu, I., 2020). Searching and using various media tools while developing digital content with the help of various online resources helps in increasing technological skills (Ciğerci, F. M., 2020). The efficiency in using mobile devices in daily life impacts the digital competence level of pre-service teachers (Erbakan, 2015). The use of online open course platforms in training student teachers to create digital content and to make them aware of safe and responsible use of technology helps in enhancing their digital competence (Gordillo, 2019). Pre-service teachers are required to be taught to integrate technology

in almost all the semesters of the teacher education programme and the experiences of technology experts, in-service teachers and teacher educators should be incorporated in these programmes. By doing this, they would get proper exposure to reflect on digital pedagogies (Dorner, 2016). Findings from a study revealed that the Instructional Technology and Material Development (ITMD) course in Turkey helps prepare pre-service teachers for their professional life and gives freedom to pre-service teachers to use their creative abilities in designing required course materials (Goktas, 2008). Yigit (2020) had conducted a phenomenological analysis and asked the pre-service teachers to create their digital stories by using appropriate software. After analysing survey and interview data, it was suggested that proper training must be given to pre-service teachers to get an understanding of technology and creative ways of using it in the classroom.

Access to technology

Majority of the pre-service teachers believe that the use of digital material in the classroom can be beneficial in grabbing the attention of learners and increasing their motivation in the classroom, but access to high-speed internet and user-friendly technological equipment are required for the smooth functioning of teaching-learning activities (Demirkan, Ö. 2019). The access to mobile devices and their efficient usage impacts the digital competence level of teacher candidates (Erbakan, 2015). The constant availability of internet and ICT infrastructure in teacher education institutions helps teacher candidates to collaborate and communicate with their peers and become more digitally competent. (Korucu, 2016). Yerdelen-Damar (2017) Stated that access to technology has a direct relationship with the technological competency

of pre-service teachers. The open access to user-friendly software and technological support enhances their interest in developing technological competencies.

Lee (2013) found in their study that the teacher education institutes must provide access to technology and training to their students to give better exposure to technology. Kimmons (2015) also suggested in a study where they applied pre-test and post-test surveys to self-assess the technological competency of pre-service teachers. The results indicated that the teacher education programmes need to involve meaningful technological integration programmes to assist students in careful selection and critical evaluation of technology in the classroom.

Discussion and Suggestions

This review highlights the major issues which are hindering the growth of pre-service teachers in being digitally competent. The studies had shown that the attitude and belief of pre-service teachers can be changed regarding their future intentions of integrating technology by giving proper practice and training. Most of the studies revealed that there exists a gap between theory and practical experience among pre-service teachers. The knowledge, skills and right approach of using technology can majorly affect the professional growth of these teachers (Çebi, A. & Reisoglu, I., 2020; An, Y., 2018). Following recommendations on the major aspects of the DIGCompEdu framework are discussed and suggested for pre-service teachers' professional digital competence development in the digital learning environment.

For professional growth

For professional growth, the pre-service teachers need to critically analyse the use of various digital tools and

techniques in educational contexts. They need to change their beliefs and look for positive attitudes for using technology in the classroom effectively. The pre-service teachers need to spend more time in a digital environment to ensure their professional and academic growth. (Altun, D., 2019; Cebi, 2020). Researches have revealed that the professional development programmes significantly affect the attitudes and perception of pre-service teachers. The training programmes can prove to be beneficial for the professional growth and development of pre-service teachers (An, 2018). Korucu (2016) suggested that teacher education institutes need to take more effective steps to assist pre-service teachers in developing skills related to technology integration. Future researchers can also concentrate on the effects of these professional training at each aspect, such as organisational communication, professional collaboration, reflective practices, and digital continuous development of professional engagement to make pre-service teachers ready for the professional world.

Being aware and knowledgeable of digital resources

It has been identified in online surveys and interviews that the appropriate knowledge of digital resources; selection of digital tools and creation of technology-integrated instruction helps the pre-service teachers to prepare for integrating technology in the classroom (Hong, 2013). Kimmons (2015) suggested that the technology should be selected carefully in teacher education programmes. To enhance the performance of student teachers should be an important aspect of these programmes so that the teachers can do a critical evaluation and reflect on the innovative practices of such tools. Cebi (2020) Stated that the knowledge and

skills in selecting, developing, managing and sharing such resources should be provided in the pre-service teacher training programmes which can help student teachers to be more confident in using upcoming digital technologies meaningfully. There is a requirement of giving practical experience of ICT tools to student teachers in their teacher education programmes to make them digitally competent (Goktas, 2008).

For effective guidance and assessment

Studies indicate that the skill and knowledge of various digital tools can help student teachers to enhance the effectiveness of teaching and will help in experimenting with the various new ways of providing support to the learners and in assessing their performance (Yerdelen-Damar, 2017). The planning and designing syllabus according to the needs of learners will benefit pre-service teachers in critically analysing and digitally verifying the activities of learners (Kimmons, 2015). The gaps in the studies show that the pre-service teachers lack the required competence of using digital equipment for providing required support and guidance to their learners. (Cebi, 2020). Some studies have proven that technological challenges indirectly affect the intention of using such technologies in future classrooms. (Ju, 2018)

For facilitating learners' Digital competence

Kimmons (2015) suggested that it is important for teachers to accept that they are going to be the facilitators of digital natives. They need to have good command over accessing, creating and effectively utilising such digital resources to get their learners acquainted with a better understanding for its meaningful exploitation. Demirkan (2019) also insisted on developing a positive attitude towards integrating technology in the

classroom and developing higher self-efficacy towards technology that can help pre-service teachers in using digital tools in communicating, collaborating and actively engaging learners into the classroom. The studies have suggested that the teacher education institutions can utilise various effective ways such as providing practical experience; mentor guidance; interaction with technology experts and updating knowledge of student teachers at all the levels of teacher training programmes to help these student teachers to have a positive attitude and in future they can facilitate their learners to help to make a digitally competent society. (Barak, 2014; Dorner, 2016; Yigit, 2020).

Conclusion

In the present study, the reviews that are included revealed that there is a dire need of exposing the pre-service teachers to the digital world. The UNESCO ICT-CFT framework and DIGCompEdu Framework show how teachers can be envisioned as the makers of digital societies. In developing nations, such frameworks can work as an example to transform the face of the digital world. The governments can collaborate with private industries to provide latest digital resources to teacher education institutions to improve their conditions. Further, more specialized research can be promoted in the field of teacher education with special focus to implementation of such digital frameworks.

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