

Digital Competence Frameworks in Teacher Education

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Abstract

For the quality training of future teachers, it is necessary to have a clear action plan, benchmarks, metrics, and progress indications for using technologies in education. Pre-service teachers' digital competence frameworks can guide their preparation and develop sufficient digital competence before actual practice. This paper analyzes the relevant literature that presents the available ICT competence frameworks for educators. The literature review findings indicate a need for an empirically validated pre-service teachers' digital competence framework that can be adjustable to the context and guide initial teacher preparation in developing modern pre-service teachers' digital competence. The paper also provides information and recommendations to those involved in initial teacher training development, research, and the integration of technologies into pre-service teacher education.

Keywords: *digital competence, ICT competence framework, teacher education, pre-service teacher*

Literature Review

Introduction

This literature review aims to explore, select, and analyze Information and Communication Technologies (ICT) or digital competence frameworks to develop pre-service and in-service teachers' digital competence. For Tinio (2003), the term "ICT in education" encompasses radio, television, computers, the Internet, and the latest digital technologies applied in education. ICT applies new forms of education, expands students' achievements, develops students' curiosity and unique skills, as well as diversifies education, and makes it more accessible (Das, 2019).

The role of modern teachers has expanded significantly. Effective use of technology in their teaching practice is a necessity. Moreover, the pandemic created a paradigm shift for all. Educators were forced to work online and apply technologies and digital teaching methods (Arndt et al., 2021). Some current studies reveal that teachers still struggle with ICT implementation in the classroom and the transition to digital distance learning, which was exacerbated by Covid-19 (Pozas & Letzel, 2021). In addition, the Covid-19 pandemic and the transition to emergency learning have forced teachers to rethink their pedagogical role in a digital learning environment and the role of students as "self-organizing learners, active citizens, and autonomous social agents." (Rapanta et al., 2021, p.715).

Rapidly changing digital time requires a digital society. According to UNESCO (United Nations Educational, Scientific and Cultural Organization, 2011), students' ICT skills directly depend on teachers' digital competence. One of the factors for students' effective education, future employment, and participation in public life is the ability of teachers to use ICT in the classroom (UNESCO, 2011; Brun & Hinostroza, 2014). Teachers play a crucial role in developing students' digital literacy, which prepares students to work in the emerging digital labor market (Botturi, 2019). There are multiple definitions of digital competence. Several frameworks define the teacher's digital competence as a complex concept involving the ability to understand and work with technology, plus its pedagogical and practical applications (Tondeur et al., 2018). Digital competence is the confident, critical, and creative use of ICTs in teachers' educational practice (Ferrari, 2012; Janssen et al., 2013, as cited in Milutinović, 2019). Professional digital competence is vital in the classroom and has become the daily practice of modern teachers (Gudmundsdottir & Hatlevik, 2018). This is even more relevant in the post-pandemic period. Therefore, the importance of the teacher's digital competence in education is unquestionable.

Initial teacher education has become a conduit for integrating ICT practices in schools. Many scholars highlight the importance of ICT in teacher preparation (Starkey, 2020; Tondeur et al., 2017; Uerz et al., 2018). Therefore, there has been a significant increase in academic attention to ICTs, and teacher education has the primary responsibility in ensuring that those tools are used effectively (Brun & Hinojosa, 2014). Pre-service teachers need to realize the full potential of digital technologies in the classroom through appropriate training and guidance (Spiteri & Chang Rundgren, 2020). Teacher education must quickly adapt to the school context, which constantly changes with the integration and change of digital technologies. Applied research can help to guide pre-service teacher training programs and practices (Starkey, 2020). Lim et al. (2011) stated that the essence of teacher education is to prepare teachers who are constantly learning, developing, retraining, and working with technology. Almost a decade later, scholars are still calling for teacher training to be adapted to the new realities, so pre-service teachers can be ready for work in a school with digital education systems and have the necessary digital competencies (Starkey, 2020).

There are several digital competence frameworks for educators. Reviewing some of the most frequently encountered frameworks is necessary to understand what set of interrelated competencies or frameworks is needed for initial teacher education.

Methods

For this literature review, Google Scholar, EBSCO, ERIC, SpringerLink, JSTOR, Physical Education Index, and SAGE databases were employed. Moreover, Google was used as a search engine. The following keywords were used for the relevant articles - initial teacher* OR pre-service teacher* OR teacher* OR future teachers AND digital education * OR ICT competence * OR Online education. Also, the combinations of keywords were employed, such as pre-service teacher education* OR pre-service teachers' digital competence * OR pre-service teachers' ICT competence framework and * OR teachers' digital competence framework * OR ICT competence framework.

An extensive search for manuscripts resulted in a collection of about 50 works that were screened and reviewed. Then they were subsequently excluded from the review for lack of purpose and established inclusion criteria. We limited the search to Scholarly (Peer-reviewed) journal articles written in English and frameworks compiled by organizations (e.g., UNESCO). Due to the rapidly changing nature of educational

technology, relevant literature has been limited to the last 30 years. Overall, nine works that reported on digital competence frameworks for pre-service and in-service teachers were included in this literature review.

Findings

Prior to discussion and making recommendations, we first review the digital competence frameworks relevant to teacher education. This literature review has identified six digital competence frameworks.

UNESCO released three versions of ICT frameworks in 2008, 2011, and 2018, reflecting technology in education, considering the popular technologies (UNESCO, 2018). However, this literature review reports the analyses of the most recent version of the framework that can ensure the dynamics and relevance of the study. In 2018, UNESCO updated the ICT Competency Framework for Teachers (ICT CFT), which consists of 18 competencies that form six aspects of the digital professionalism of a teacher. These include: A) Understanding ICT in Education Policy; B) Curriculum and Assessment; C) Pedagogy; D) Application of Digital Skills; E) Organization and Administration; and F) Teacher Professional Learning. According to this framework, teachers who possess all the above mentioned digital competencies will professionally teach and guide the development of students' digital competencies (UNESCO, 2018). This framework also involves three consecutive stages in progressing digital pedagogical competence. The first level – is "Knowledge Acquisition" (or "Technology Literacy" in 2011 ICT CFT) which defines essential ICT competencies and gaining knowledge about the use of technology. It includes the benefits of using ICT in the classroom, the framework of national policies and priorities, the use of technology throughout life, and further professional development (UNESCO, 2018). The second level is "Knowledge Deepening," which involves the creation by teachers of a study process aimed at students' collaborative and cooperative work. The third level is "Knowledge Creation." Teachers have the competence to model best practices and create a learning environment where students already act as creators of new knowledge for society (UNESCO, 2018).

Another framework is the well-known TPACK (technological, pedagogical, and content knowledge) model. PCK (pedagogical content knowledge) of Shulman (1987, 1986) became the basis for the TPACK framework, which determined teachers' understanding of educational technology and interaction with PCK for effective learning

with technology (Koehler & Mishra, 2009). There are three main components in the TPACK framework which, when interacting with each other, form new one such as PCK, TCK (technological content knowledge), and TPK (technological pedagogical knowledge) (Koehler & Mishra, 2009). TPACK is a complex framework through which effective technology-assisted learning can be achieved. It involves understanding technological concepts, digital pedagogy, understanding the complexity and ease of concept to learn, assisting technology in solving student problems, theories of epistemology and knowledge of students' prior knowledge, the appropriate use of technology with a foundation on existing knowledge and the creation of new epistemologies or strengthening old ones (Koehler & Mishra, 2009, p. 66). Integrating technology in education lies in the complex understanding of the relationships between content understanding, teaching understanding, and technology understanding and the difficulty of their joint application in different and dynamic classroom contexts (Koehler & Mishra, 2009). The TPACK structure has the advantage that it does not treat technology as an add-on but emphasizes the links between technology, content, and pedagogy used in the classroom (Koehler & Mishra, 2009).

The International Society developed Standards for Technology in Education (ISTE). This framework, updated in 2014, specifies what ICT skills teachers need and their actions for effective technology integration (De Santis, 2016). The ISTE Standards include: "Facilitate and Inspire Student Learning and Creativity (SLC), Design and Develop Digital-Age Learning Experiences and Assessments (DALEA), Model Digital-Age Work and Learning (DAWL), Promote and Model Digital Citizenship and Responsibility (DCR), and Engage in Professional Growth and Leadership (PGL)" (De Santis, 2016, p.19). While these standards have performance indicators that describe technology-informed teaching methods, they do not interpret technologies and give teachers freedom of choice depending on the purpose and time. Thus, these standards remain relevant despite constantly changing technologies (De Santis, 2016).

NetWork at the Ghent University Association has developed a framework for pre-service teachers in Belgium (ENW AUGent, 2013). The main idea is to integrate the existing ICT framework into provisions for the rapid development of ICT competencies. This framework focuses on the three main domains: 1) "instructional and pedagogical objectives, 2) professional development, and 3) the school in a broader context" (Tondeur et al., 2017, p. 4). This is an example of a pre-service teachers' contextual framework. Tondeur et al. (2017) emphasize the importance of future teachers' ICT framework and its empirically verified significance. The authors propose the ICT-CF (ICT competence framework) scale for use in initial teacher education and a transparent

understanding of the pre-service teachers' digital competencies (Tondeur et al., 2017, p. 9). The research on this framework has been conducted in the context of a single region, so more research is needed.

The next framework reviewed is the National Council for Curriculum and Assessment (NCCA) ICT framework which is a structured approach to ICT in curriculum and assessment. This framework originated in Ireland for primary and secondary teachers (Ferrari, 2012). It describes the introduction of ICT for all subjects as an interdisciplinary framework. The NCCA ICT framework informs educators to improve ICT literacy by creating, collaborating, understanding, using, and critically evaluating ICTs in learning and society (Ferrari, 2012). Besides, ICT Knowledge, Skills, and Attitudes are necessary components that students are expected to receive in primary and post-primary education. The framework structure is constructed of four interrelated and interdependent elements: A.) creating, communicating, and collaborating using ICT; B.) developing fundamental knowledge, skills, and concepts for using ICT; C.) applying ICT in critical and creative thinking processes; and D.) understanding the social and personal impact of ICT, including responsible and ethical usage of ICT (Ferrari, 2012, p.78-79). However, this framework has not been widely adopted and has not been considered in many studies.

Finally, we discuss here the eTQF (European Teachers Competency and Qualifications Framework), which was created to support the development of teachers' digital competence. As part of the eTQF project within the EU (European Union) Lifelong Learning Project, it was established through collaboration between Fast Track into Information Technology, City of Dublin Vocational Education Committee (Ireland), Consortium FOR.COM (Italy) and South West College (UK) with the support of H2 in Ireland (eTQF, 2010, p.2). The framework includes four competence categories (ICT, Pedagogy, Curriculum and Assessment, Teacher professional development) and four skill levels that include one or more competencies (e.g., Basic Tools, Complex Tools, Pervasive Tools in ICT Section) (eTQF, 2010). According to the framework, a teacher must have 13 competencies to reach the skill level, while the total number of competencies is 52 (Zervas et al., 2014; eTQF, 2010). The categories are arranged in order of progress from technological to methodological and didactic use of ICT (eTQF, 2010). This framework considers the development of ICT competence and commences from using ICT as a tool for communication, collaboration, and lesson planning to the professional development of teachers and non-professional development with ICT. Moreover, an online digital competence self-assessment tool for teachers has been developed based on this framework. It allows teachers to identify their

strengths/weaknesses and outline suggestions for continued improvement. After the assessment, teachers receive results in one of 4 levels (gold, silver, bronze, or introductory) (eTQF, 2010).

Discussion and Conclusion

As this review has shown, there are diverse frameworks and standards to evaluate educators' digital competence. The analysis revealed that digital frameworks generally reflect the context of one country or region, although they can be used in many countries. For instance, ISTE (2008) standards were developed in the United States and raised the issues of teachers' growth, professionalism, and innovation (Tondeur et al., 2017). All 50 US states and several countries have adopted this framework. On the other side is Expertise NetWork for pre-service teachers, developed by Ghent University Association in Belgium. The development of the framework was carried out considering the Flemish context and relevance to stakeholders who work in this country (ENW AUGent, 2013).

Overall, three digital competence frameworks were revealed for pre-service teachers in this literature review. Among them, as Milutinović (2019) mentioned UNESCO ICT Competency Framework (2011) and the ISTE standards (2008). UNESCO ICT-CFT is the international framework applied to many global contexts (Zervas et al., 2014). UNESCO ICT CFT is central for many countries worldwide, including revising the national curriculum standards for teacher training. UNESCO ICT CFT has proven to be effective in some countries (especially in developing nations), transformative, and relatively cost-effective in creating its pedagogical strategy (Butcher et al., 2014). However, UNESCO ICT CFT is a theoretical framework that requires contextualization for the individual country that adopts it (Ministry of Education and Vocational Training, & UNESCO Office Dar es Salaam, 2015). Besides, a case study in Tanzania revealed that teachers had moved beyond basic understanding and use of ICT tools. They need competencies to properly apply technology in the classroom to improve teaching and learning (Mtebe, 2020). Mtebe (2020) concludes that teacher training courses should be aimed at developing technical and pedagogical skills for integrating ICT in schools. At the same time, UNESCO ICT-CFT can be used as the foundation for teachers to define and regulate their digital competencies (Mtebe, 2020). Therefore, this framework is not entirely suitable for application in the context of the training of future teachers since the level of digital competencies has grown

significantly, and the digital pedagogical competence of prospective teachers has become a new requirement of the time.

TPACK is a foundational framework for teachers. It is one of the primary guidance for teachers about mastering technology and effective teaching (DeSantis, 2016). Tondeur et al. (2013) suggest the implementation of TPACK in pre-service teachers' curricula so that they develop an awareness of the possibilities of ICT in teaching and learning. DeSantis (2016) calls for a more critical approach to using the TPACK framework for assessing teachers' digital competence and emphasizes that none of the frameworks should be used as a single method. Mtebe (2020) also says that "good teaching requires an understanding of the technology itself and how that technology can be applied in the specific context of the classroom environment" (p. 352). Therefore, scholars recognize the need for a critical pedagogical approach of the use of technology in the specific classroom. Later, Tondeur et al. (2017) noticed challenges with TPACK instruments for measurement growth components among pre-service teachers. Nguyen et al. (2022) state the need to extend the TPACK model and include Design Knowledge (DK) and Context, which will help future teachers to develop the ability to digital design in a particular context.

Although some digital competence frameworks are international and reputable, they are not entirely applicable to the current initial teacher education needs. There are various definitions and aspects of digital teachers' competencies, concepts of digital literacy, ICT literacy, etc. Furthermore, they vary significantly depending on the social, cultural, academic, and other contexts (Milutinović, 2019). According to Koehler and Mishra (2009), there is "no one best way to integrate technology into the curriculum" (p.62), so they maintain the necessity to be creative in the process of introducing technology applicable to a specific subject and in specific classroom settings. Finally, Tondeur et al. (2017) noted that the frameworks for future teachers are developed at a conceptual level and are not sufficiently confirmed empirically. Consequently, pre-service teachers' digital competence framework should be contextually adjustable, empirically, and practically validated. Also, design and context knowledge should be included as crucial components of modern pre-service teachers' competencies. Thus, it is essential to study the need for an international pre-service teachers' digital competence framework to structure their preparation at university and assess the level of digital competency preparedness for specific contexts.

A literature review and analysis have been completed, but further confirmation of the findings is necessary as the study is limited in time, the number of participants,

countries, and information covered. A comprehensive analysis of factors, empirical studies, and practical application of digital frameworks are essential for more complex suggestions. This may allow for more accurate development of an international pre-service teachers' digital competence framework that can be modified to meet the needs of the individual education system.

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