Rethinking preparing pre-service teachers with 21st-century skills: What is the higher learning institution need to devise for this idea?

Abel, Ruhogo
Beijing Normal University, China

Jun, Teng
Beijing Normal University, China

Dady, Ntide ✉
The Mwalimu Nyerere Memorial Academy, Tanzania (Ntide.dady@mnma.ac.tz)

Abstract

This study draws attention to the qualitative papers that concentrated on preparing pre-service teachers with 21st-century skills. A meta-ethnography method was used to trace, evaluate, and synthesize the data from twenty-two qualitative research investigations to acquire a better understanding of how to equip pre-service teachers with 21st-century skills. Based on the subject covered and the teaching methods used by higher learning institutions to provide preservice teachers with 21st-century abilities, the results of the first phase of the question identified nine themes. Conversely, core and contextual skills were covered. An extensive review of sample studies assessing skills to be communicated to pre-service teachers was looked at to better understand variations in the quality of these skills among pre-service teachers. The findings demonstrate the importance of preparing pre-service teachers with 21st-century skills and the types of skills that should be communicated to them, as these skills focus on developing pre-service teachers who are thoughtful, reflective thinkers and inquiring, problem solvers, decision-makers, and can use digital technology to overcome unprecedented challenges. Recommendations for more research are explored by integrating the review's findings.

Keywords: 21st-century skills, 21st-century competencies, ICT skills, digital literacy, twenty-first-century skills, pre-service teachers, higher learning institutions

Rethinking preparing pre-service teachers with 21st-century skills: What is the higher learning institution need to devise for this idea?

1. Introduction

Today as never before, teachers are expected to have broad and deep knowledge and skills of subjects they teach and adequately being prepared for 21st century challenges zero in on technology, globalization, and labor market dynamics (Barber & Mourshed, 2017; Darling-Hammond, 2018). As, they are the main drivers of the ongoing movements for educational reforms that calls for a paradigm shift from traditional education, focuses on imparting knowledge to the learners, to a contemporary education form that values the knowledge, skills, and abilities of learners (Ananiadou & Claro, 2009). The main emphasis of this movement is the development of creative and critical thinking skills, problem-solving, reflecting thinking, decision-making, reasoning, and integration of digital technology to handle modern problems (Osmon et al., 2010; Trilling et al., 2009). Cultivation of skills among learners is thus a backbone in proposed transformation in education. It directly relating with the integration of 21st-century skills into all levels and aspects of education system (Shultz et al., 2017). As Cachran-Smith and Lytle (2016) comment, the foundation for preparing pre-service teachers with 21st-century skills, is to shift away from preparing pre-service teachers to be technicians, transmitters, and implementers of knowledge and instead focus on preparing teachers who are thoughtful, reflective thinkers and inquiring, problem solvers, decision-makers, and could use digital technology to overcome unprecedented challenges (p. 16).

However, some studies have generating alarming results that few new teachers enter the profession with required abilities and in-depth knowledge needed to address the wide range of educational difficulties that exist today (Desveaux & Guo, 2016; Goddard, 2018). Many pre-service teacher candidates lack the necessary professional abilities to engage in global citizenship and become responsible for fostering a world that is more fair, environmentally safe, and peaceful while undergoing training in higher institutions (Reimer & McLean, 2019; Weber et al., 2018). In relation to this challenge, higher education institutions have been challenged for failing to train teachers who are sufficiently rooted in the spirit of inquiry, creativity, pedagogy, content, intellectual background, and professional experience that will prepare them for their tasks and enable them to adapt to changing circumstances (Ololube, 2016).

Therefore, there is a need for a global dialogue on inquiry in higher education institutions and more high-level research that outlines the fundamental elements of institutions of higher learning that prepare pre-service teachers to be inquisitive thinkers, researchers, and adaptable to the changing world (Shultz et al., 2017). In this context, this review seeks to close a gap in the existing literature on the development of 21st-century skills in pre-service teachers. The preparation of teacher-students for 21st-century learning practices (PREP 21) has previously been the subject of literature studies, but none of these reviews consolidated trends and findings on higher education institutions' efforts to equip pre-service teachers with 21st-century skills. This review is the first to start an evidence-based discussion about how universities might equip aspiring teachers with 21st-century skills.

1.1 Purpose of the Study

Across cultures and continents, pre-service teacher preparation programs take a variety of approaches, but all reputable higher learning institutions for teachers emphasize building 21st-century skills. This study is an effort to answer the two major research questions: (1). What contents and instructional strategies should higher learning institutions employ to equip preservice teachers with 21st-century skills? (2). What 21st-century skills should higher learning institutions impart to pre-services teachers? A peer review was done to fill this gap in the literature. According to Moher et al. (2019, p. 264), peer review means "A framed inquiry that employs

systematic and explicit processes to locate, select, and critically evaluate relevant research and to gather and analyze data from the studies that are included in the review." The benefit of such a peer review is that it results in a comprehensive understanding of the circumstance.

2. Research Method

Meta-ethnography Approach - To synthesize qualitative evidence for this study, the researchers employed a systematic meta-ethnography approach (Janss et al., 2019). According to recent studies, the meta-ethnography method can be appropriately employed in educational studies (for example, Tondeur et al., 2017; Noblit & Hare, 1988). A qualitative study's meta-ethnography reaches a certain conceptual or theoretical level and "serves to uncover what is hidden in individual studies and to discover a whole amid a set of pieces," (Campbell et al., 2003, p. 680). The researchers employed participant reports (first-order constructs), which Schuiz (2019) refers to as first and second-order constructs, to interpret the phenomenon under study (second-order construct). In meta-ethnography, a new model or theory is created by combining first-order and second-order components (third-order construct).

Search Strategy - The best relevant papers were found using a variety of search techniques. ProQuest (the Ed. Database), Web of Science, ERIC, and EBSCO were used to find pertinent papers and online databases because they are the most reputable and well-known in the social sciences sector. Keywords linked to "21st-century skills" OR "21st-century competencies" OR "digital skills" or "ICT skills" or "digital literacy" OR "twenty-first-century skills" OR "pre-service teachers" as well as "higher learning institutions" and (define OR review). These keywords were searched for each database to ensure that more studies were covered. Peer-reviewed journal papers were favored as one of my research selection criteria since they are thought to be more trustworthy sources of scientific data.

Selection Criteria - To choose the most pertinent studies, a range of criteria were established. The restrictions of document type "peer-reviewed publications," language "English," and period were limited to the years 2018 to 2022. The article had to meet one or more of the requirements listed to be accepted: Studies centered on preparing pre-service teachers with 21st-century skills, studies went into detail about how pre-service teachers are trained in teacher-training programs or institutes of higher education, studies centered on the skills that pre-service teachers in the twenty-first century need to know, when discussing pre-service teacher preparation, bring up the concept of 21st-century skills, published in a journal that has undergone peer review. Since these journals are regarded as the most trustworthy sources of scientific information, and studies detailed issues with 21st-century skills.

Study Selection - Using Boolean search actions, 355 articles were found that fell within the parameters of the document type and language. 140 of the 355 articles were duplicates, so 215 unique articles were screened out of the original 355 articles. 22 articles that matched all six inclusion criteria were read in full after 121 had been screened based on title and abstract. Additionally, a modified version of the CASP was used to analyze the 22 papers that were chosen (Critical Appraisal Skills Program, 1988). The 22 studies' reported results were examined in this step to determine their quality and whether there were any significant gaps. Other sources failed to identify further records since the references in the included articles did not add to the information already available. The full-text screening was rejected for the following seven reasons: (a). Not Mentioned in the context of pre-service teacher preparation (b). The total absence of a 21st-century skills operationalization (c). Vague and general discussion of the 21st-century skills (d). Non-compliance with inclusion criteria (e). Not a peer-reviewed articles published in journal (f). No full-text in online platforms (g). Book(s); and (h). Conference reports.

3. Findings of the Study

The presentation of the review's findings is divided into three main sections. The first section discusses the overall characteristics of the papers being examined. The second discusses the content and strategies for

preparing pre-service teachers for the 21st-century skills competencies, and the third section focuses on the 21st-century skills that higher learning institutions should convey to pre-service teachers.

3.1 Characteristics of the Studies

The summary of the basic information of the reviewed 19 papers and integrated data from the participants.

Table 1

Background information about the reviewed papers

The publication year	2018 (5), 2019 (5), 2020 (4), 2021 (4), 2022 (4)
Context of study	Asia (9), Europe, (4), North America (6), Africa (3)
Respondents'	In-service teachers, pre-service teachers, and university instructors
Data collection methods	Classroom observation, interview, survey, case study, open-ended questions, focus group discussions, mixed method, survey, semi-structured method.

3.2 Synthesis findings

This part includes a thorough analysis of previous studies to elaborate on the research topic and approaches for preparing pre-service teachers in contemporary teaching and learning environment. This section accomplishes one of the main goals of the study by responding to the first research question. '*What contents and instructional strategies should higher learning institutions employ to equip preservice teachers with* 21st-century *skills?*' To address this question, we conducted a thorough analysis of carefully chosen papers that addressed various topics and instructional approaches for equipping teachers with 21st-century skills. Based on the synthesis, the findings executed ten arguments for content and delivery methods that if used by higher education institutions can prepare pre-service teachers with 21st-century skills. The synthesis findings are reported below one after another.

3.3 Contents and instructional strategies institutions employ to equip preservice teachers

Designing content knowledge program. 10 out of 22 studies highlighted pre-service teachers have abilities to plan and coordinate tasks well, communicate effectively, use technology, and reflect on their practice to continuously learn and improve it (Önür & Kozikoğlu, 2020). The studies pinpoint the higher learning institutions to construct understanding of content, or the actual content to be taught or learnt by pre-service teachers, they need to know and understand concepts, theories main facts as well as steps to be followed in a respective area of study, understanding of the rules of proof and evidence and understanding of the structures used to organize and link thoughts (Kim et al. 2019; Suh, et; 2021). Moreover, three studies specified that higher learning institutions must train prospective with deep knowledge on contents which are relating with cultural and social settings (Yan & He, 2018; Joynes & Amonoo-Kuofi, 2019). Preparation programs for both practising and prospective teachers should target to develop pedagogical content awareness and knowledge on how problems, issues, or topics are presented, organized, and adapted to a range of teaching and learning contexts (Johnson & Templeton, 2018; Shadiq & Yamtinah, 2019).

Translating theory into practice. This argument was noted in six peer-reviewed studies. The evidence exposed that pre-service teachers need to develop and gain proper competencies in all time of their initial training to be able to promote 21st-century skills in their environment (van Laar et al., 2019). Expressing the role of higher institutions, González-Lim and Tay (2019) stipulated that pre-service teachers need to be provided with knowledge and skills of how educate lifelong learners, adapt to diversity by multiplying pedagogical practices, and teach complex ways of thinking. To help them make better judgments, they must possess a greater understanding of how to handle a variety of situations and improved diagnostic skills. Continuous information flow and modification are necessary for effective communication in such a complicated context (Karsanti et al., 2019), and it is important for skilled pre-service instructors to practice controlling the conversation's ebb and flow (Dede, 2017). Furthermore, two studies illustrated that the issue of clinical schools is needed for pre-service

teachers with 21st-century skills. Clinical schools help pre-service teachers transform knowledge through coursework into skilled practice, and it exposes teachers to real teaching for a long time (Teo et al., 2021). Higher learning institutions need to prepare pre-service teachers by using a range of teaching strategies and skills like participatory learning and classroom management and technology use in working with learners from diverse backgrounds.

Developing VSK model. VSK refers to Values, Skills, and Knowledge. Four peer-reviewed studies cited the term "VSK model" and argued that good pre-service teachers need to have skills including reflective skills and thinking disposition, pedagogical skills, people and self-management skills, administrative and facilitative skills, technological skills and entrepreneurship skills, as well as social and emotional intelligence (Yan & He, 2018; van Laar et al., 2020). Based on the collected evidence from nine and twelve peer-reviewed articles, for higher education institutions to nurture the learning needs of 21st-century, pre-service teachers ought to be knowledgeable about themselves, their communities, their fields of study, curriculum and pedagogy, educational foundations and policies, environmental awareness, and intercultural literacy (Alamad et al., 2021; Häkkinen et al., 2021). The value, skills, and knowledge components are closely aligned to prepare pre-service teachers to be individuals who are self-confident, active participants, and civically engaged (Toibazarov et al., 2022).

Developing training model. Based on the overall comments, discussing and sharing concerns with higher learning educators six out of twenty-two studies accept for the higher institutions to introduce an innovative and transformative pre-service teacher education system for the 21st-century that seeks to renovate the higher education institutions system to incorporate 21st-century skills, values, and professional development into teacher trajectory (Urban et al., 2017; Durgesh, 2020). The peer review number two remarked that the model can intend to include innovative skills; information, knowledge, technology literacy, and media, skills; citizenship skills; and life skills (van Laar et al., 2019). Furthermore, peer review number seven clarified that to prepare pre-service teachers for the above skills higher education institutions need to focus on three areas: in teacher training: knowledge of how to support learning communities to implement 21st-century skills in the real-world context; effective instruction in 21st-century skills that support advanced teaching and the application of high order thinking skills and proficiency which are connected to information and digital media (Guo-Brennan, 2022).

Adapting policy integrates 21st century skills. This was another issue that emerged in eleven of the sample studies which emphasized that adapting an educational policy that integrates 21st-century skills into higher learning institutions can help pre-service teachers procure all aspects of the policy to be of a high level of cooperation and harmony (Suh et al., 2021). The transformation policy adjusts curriculum, standards, personal development, assessment, and education to support to support 21st-century skills (Alahmad et al., 2021). Moreover, 21st-century skills bring a change to the traditional duties and roles of teachers. Those with 21st-century skills take the role of facilitators and counselors who encourage the growth of students, assist them in achieving their learning objectives, and give them ongoing feedback on their progress (Shadiq & Yamtinah; 2019).

Support from curriculum and other resources. This was prominent as a key theme in fourteen studies. The evidence confirmed that in delivering 21st-century skills, pre-service teachers need support from higher education institutions educators, curricular materials and other tools that give teachers the frameworks they need for educating students about and evaluating their mastery of the variety of 21st-century capabilities (Guo-Brennan, 2022; Horváth-Csikós & Cseh, 2021). The eleven studies noted vowing that feedback on interpersonal and professional skills that support effective cooperation, communication, and critical and reflective thinking must be incorporated into any systematic education and practice environment (Astuti, 2019). Furthermore, peer review number three claimed that higher education institutions must develop an approach that adopts a value-centric framework that will be implemented in all core curriculum and integrates a range of 21st-century skills including global awareness, civic literacy, and cross-cultural skills; collaboration, information, and communication skills, emotional skills as well as inventive and critical skills (Teo et al., 2021, Ghavifekr et al., 2020).

Dual training and special education. The research results demonstrated the importance of preparing pre-service teachers as a group that can handle inclusive classrooms (in four out of 19 studies). Research carried out by Häkkinen et al. (2018) found that prospective teachers are not nurtured to interact and handle students with special learning needs. Bedir (2019) and Singh (2020) state that dual training in general and special education may cultivate pre-service teachers who are much interested and proficient to handle students of diverse learning needs in the same regular classes, as supported by van Laar et al. (2020) who asserts that higher education institutions must train pre-service teachers with deeper knowledge on the teaching on diverse learners. Also, the current content on pre-service teacher preparation needs to be improved to involve skills in the handling of special learners (Ng, 2022).

Incorporating new technology. Higher learning institutions should train twenty-first-century pre-service teachers who are familiar with the new technology and incorporate it into classroom teaching (in 8 out of 22 studies). Pre-service teachers need to have skills in operating technologies, which include knowledge of operating systems and computer hardware and the use of standard sets of software tools such as word processors, spreadsheets, browsers, and e-mails. Further to this, pre-service teachers need to understand the subject matter and how can be changed through the application of technology (Erdem, 2019). Also, prospective and practicing teachers need to understand curriculum resources and technologies to connect their students with sources of information and knowledge that allows them to explore ideas and synthesize information (in 2 out of 22 studies). For this to happen, teachers need to be trained to use technology.

Integrating the 21st century knowledge framework. Seven out of the sample studies acknowledge the Technological, Pedagogical, and Content Knowledge (TPACK) framework. The framework outlines the types of knowledge pre-service teachers are encouraged to attain to successfully integrate and teach with technology (González-Pérez & Ramírez-Montoya, 2022). TPACK is an influential framework in the ways pre-service and in-service teachers use technology. The TPACK framework focuses on three core domains: pedagogical decision-making and understanding, specific content knowledge for a given subject or topic, and understanding of how to select and use technology to facilitate student learning (Karakoyun, & Lindberg, 2020). It considers the "thoughtful interweaving" of all three key sources of knowledge: technology, pedagogy, and content. This framework has received significant attention from researchers (e.g; Tay, 2019) as it conceptualizes pre-service teacher knowledge of technology, pedagogy, and subject-specific content to inform authentic technology integration (Önür, & Kozikoğlu, 2020). TPACK has provided a way for higher learning institutions to examine the effectiveness of authentic technology integration in teacher education (in four of the sample studies). Thus, TPACK remains a strong and relevant framework for higher learning institutions to consider the concepts of preparing pre-service teachers with 21st-century skills and technology integration. The scholarship continues to grapple with other ways to consider these skills (in eight of the sample studies).

Strengthening Knowledge, Skills, and Dispositions. The synthesis results illustrated the importance of higher learning institutions' need to improve and strengthen the knowledge, skills, and dispositions of 21st-century pre-service teachers in broader collaborative partnerships between universities, schools, parents, and communities (in eighteen out of 22 studies). This is necessary to provide intense integration of coursework and practice to prepare pre-service teachers with a profession that demands a detailed understanding and deep knowledge of child development and learning, content knowledge, and pedagogy. To make this happen, higher education institutions must be comprehensive including local, state, and national legislators where all partners work together holding each accountable for teacher performance and student learning (Karakoyun, & Lindberg, 2019, Horváth-Csikós, & Cseh, 2021). Darling-Hammond (2018) states, "Improving teaching and teacher education depends on not only strengthening individual programs but also addressing the policies needed to strengthen the teacher education enterprise as a whole" (p. 312).

3.4 The 21st-century skills to communicate to pre-service teachers

This section is aimed to address the second research question, 'What 21st-century skills should higher

learning institutions impart to pre-services teachers? This section presents a broader picture of the 21st-century skills reported by researchers and academicians in peer-reviewed studies. To conceptualize the 21st-century skills dimension that is crucial to be communicated to pre-service teachers, the researchers took into account the descriptions available in the included peer-reviewed journal articles. This study elaborates on two categories of 21st-century skills that are essential for pre-service teachers. The first is core skills and the second is contextual skills.

Core skills. These are fundamental for performing tasks that are necessary for a broad range of occupations including teaching professionals and are supported by the use of ICT: technical, information management, communication, collaboration, creativity, critical thinking, and problem-solving.

Technical skills. Higher institutions as the agents of change (in two out of 22 studies) need to prepare pre-service teachers with the skills to use (mobile) devices and applications to accomplish practical tasks and recognize specific online environments to navigate and maintain orientation (Teo, el. 2021). To maintain a competitive advantage, pre-service teachers must be fluent in the skills and languages of ever-changing technologies (in three out of 22 studies). For increasing productivity, new technology is developed, and as a consequence, technology is increasingly replacing manual labour and being integrated into most aspects of work (Bedir, 2019). Higher learning institutions need to train pre-service teachers to be capable of continuously adapting to shifting job requirements related to new skill-intensive technologies (Levy & Murnane, 2019). As workplaces have become more complex and supported by ICT, more jobs require technical skills.

Information management skills. Many studies indicated that information management means information literacy, data access, and analysis, managing multiple streams of simultaneous information, applying knowledge to new situations, creating new knowledge, and content knowledge (in six of the sample studies). The abundance of information and data implies that teachers in nearly all schools and colleges must be able to search, evaluate, and organize information, often coming from multiple sources (Karasantik & Ayaz, 2019). The quick access to a wide range of information sources means that teachers need to recognize when information is needed and to evaluate other reliability and relative value of information (Marchionini, & White, 2019, Starkey, 2019). Higher learning institutions have the role to prepare pre-service teachers to be equipped with the skills to use ICT to efficiently search, select, and organize information to make informed decisions about the most suitable sources of information for a given task (Ahmad et al., 2021).

Communication skills. The synthesis revealed that communication includes the ability to express thoughts clearly and persuasively both orally and in writing, articulate opinions, communicate coherent instructions, and motivate others through speech (Teo et al., 2021). Communication skills are also embedded in information, media, and ICT competencies (in one out of 22 studies). For example, Scott (2018) stated that communication skills are highly valued in the workplace and public life and are also shaped by current and emerging technologies, taking into account the large portion of messages that are mediated by one or more digital devices. Therefore, preparing teachers for communication skills is vital in the growing service sector including education, and concerns the ability to transmit information, ensuring that the meanings are effectively expressed by taking into account the audience and medium (Ananiadou & Claro, 2019). Pre-service teachers must be prepared and be able to effectively regulate one's needs and goals with those of the larger society to successfully navigate the current social world (in five out of 19 studies). Because of the interconnectedness of our global economy, pre-service teachers must possess communication skills (Sears & Hughes, 2017). In this context, higher education institutions need to prepare pre-service teachers with effective communication skills that can help to avoid misunderstandings and misconceptions.

Collaboration skills. This synthesis emerged as an important skill to use ICT to develop a social network and work in a team to exchange information, negotiate agreements, and make decisions with mutual respect toward achieving a common goal (in fourteen out of 19 studies). It is stated that higher learning institutions need to prepare pre-service teachers who are expected to engage in highly networked collaboration, separated from

colleagues by distance and situated far from the physical location of information resources (Ananiadou & Claro 2019). Pre-service teachers need to be comfortable with collaborating at a distance, and simulating those interactions in education will have clear benefits on the skills of the workforce. Consequently, teaching is increasingly performed by teams of teachers with complementary expertise and roles (Subramaniam, 2018). Teachers are often dependent on others to accomplish their tasks. To function interdependently, they need a clear understanding of their roles and those of their collaborating partners (Wang, 2019). In this context, clear and effective communication skills and the use of technologies and social media are key to effective collaboration.

Critical thinking skills. As discussed in sixteen out of 19 studies, critical thinking involves accessing, analyzing, and synthesizing information and is considered fundamental to 21st-century knowledge (Ananiadou & Claro, 2019). Critical thinking draws on other skills such as communication, information literacy, and the ability to examine, analyze, interpret, and evaluate evidence (Cochran-Smith & Lytle, 2019). Higher institutions need to prepare pre-service teachers with critical thinking skills to make informed choices about obtained information and communication by using sufficient reflection and reasoning. Pre-service teachers need the ability to think reflectively and judge skilfully, to decide what information or communication is relevant in a given context. To think critically, pre-service teachers need knowledge that is central to the particular domain to formulate an independent, well-grounded perspective or opinion (Van de Oudeweetering & Voogt, 2018). Pre-service teachers' preparation has to include the skills on how to use ICT to make informed judgments and choices about obtained information and communication using reflective reasoning and sufficient evidence to support the claims.

Creativity skills. Creativity is defined in terms of the capacity to generate new ideas and solutions, 'break new ground', invoke fresh ways of thinking, pose unfamiliar questions, and arrive at unexpected answers (Ng, 2022). In the context of global competition and task automation, individual capacity for innovativeness and creativity are increasingly seen as requirements for professional and personal success (in five out of 22 studies). In addition to being able to process and transmit information, it is necessary to transform information into new knowledge. Previous research has often reasoned that complex problems necessitate creative solutions. Higher education institutions must prepare pre-service teachers to be creative to produce new or previously unknown ideas or treat familiar ideas in a new way and transform such ideas into products, services, or processes that are recognized as novel and potentially within a particular useful domain (e.g; Whitaker, 2017). Because teachers' creativity is presented as an imperative for long-term organizational success (Mengual et al., 2018), it arises as a critical skill for organizations to lead or adapt to change.

Problem-solving skills. This synthesis emerged in ten out of 19 studies, clarifying that as the workforce is increasingly confronted with challenging and non-recurrent problems, pre-service teachers need the skills to solve domain-specific problems. Yeigh and Lynch (2018) postulated that situations that are complex and uncertain and that have no precedent require problem-solving skills. Problem-solving is often conceptualized as the knowledge and skills that are required to deal effectively with complex no routine situations (in eleven out of 19 studies). Although domain-specific knowledge plays an important role, it is not just prior knowledge. Teachers must identify necessary actions, possible gaps, and steps to obtain this information. Higher education institutions have the liability to prepare pre-service teachers with skills on how to use ICT to cognitively process and understand a problem situation in combination with the active use of knowledge to find a solution to a problem (Guo-Brennan, 2022).

Contextual skills. Are those skills that are required to take advantage of the core skills and, therefore, must be connected to such core skills including:

Ethical awareness. This synthesis emerged in eleven out of 22 studies clarifying the skills to behave in a socially responsible way and demonstrating awareness and knowledge of legal and ethical aspects when using ICT (McGarr & McDonagh, 2020). Pre-service teachers need to be prepared to understand ICT knowledge by understanding the characteristics of devices or applications, ICT usage how to operate basic (mobile) application

operations and access resources for everyday use, and how to navigate to avoid losing orientation when navigating online.

Cultural awareness. Sixteen studies also provided evidence for the importance of cultural awareness. Janssen et al (2018) found that cultural awareness is the skill to show cultural understanding and respect for other cultures when using ICT. Cross-cultural communication such as attitudes towards online communication and collaboration experiences with people from different cultures when using ICT. Higher education institutions need to prepare pre-service teachers to possess the ability to appreciate the value of varied cultures and to intentionally construct cross-cultural relationships and networks when using ICT (Horváth-Csikós & Cseh Papp, 2021).

Flexibility. Many studies indicated that higher learning educators have the responsibility to prepare pre-service teachers to know the skills of the 21st century. It is clear from the evidence (in two of the sample studies) that flexibility is the skill to adapt one's thinking, attitude, or behavior to changing ICT environments (Önür & Kozikoğlu, 2020). Higher learning institutions among others should aim to prepare teachers to adapt to frequent and uncertain situations such as attitudes toward modifying pre-one's thinking or behaviors to be better suited to current or future ICT environments.

Self-direction. Another issue emerging in five of the selected studies was self-direction as the skills to set goals for yourself and manage progression toward reaching those goals to assess your progress when using ICT (Sykes, 2018). Higher learning institutions need to train and prepare pre-service teachers on how to set goals by stating learning or time goals when using ICT, how to control the willingness of individuals to take control of their learning when using ICT, how to take proactive initiative or steps toward decisions and/or actions when using ICT and how to monitor progress by assessing whether previously/set goals have been met when using ICT (Kim, 2019).

Lifelong learning. Pre-service teachers acknowledged the importance of applying 21st-century skills (in 8 out of 19 studies). Engen et al. (2018) agree that lifelong learning is the skill of constantly exploring new opportunities when using ICT that can be integrated into an environment to continually improve one's capabilities. Knowledge creation efficacy is important for pre-service teachers on how to use ICT to create useful knowledge individually (Joynes et al., 2019).

4. Conclusion

Peer-reviewed studies that shed light on the development of 21st-century skills in pre-service teachers were found, screened, evaluated for eligibility (analyzed), and interpreted in this study. To provide pre-service teachers with a more thorough preparation for contributing members of a technologically advanced and information-rich society, a variety of concerns were brought to light. Ten themes relevant to the content and strategies for equipping pre-service teachers with 21st-century skills were produced as a result of the study's findings. Additionally, it was considered how to communicate to pre-service teachers seven fundamental/core skills and five contextual skills connected to 21st-century skills. A comprehensive model outlining the connections between these thematic concerns was created. To better prepare pre-service teachers with 21st-century skills to employ these skills in a variety of circumstances, policymakers, university educators, experts, and planners should use the models in Fig. 1 and Fig. 2 to communicate the review's key conclusions.

5. References

Ahonen, A. K., & Kinnunen, P. (2015). How do students value the importance of twenty-first-century skills? *Scandinavian Journal of Educational Research, 59*(4), 395-412.

Alahmad, A., Stamenkovska, T., & Győri, E.L. (2021). Preparing pre-service teachers for 21st Century Skills Education: A Teacher Education Model. *GiLE Journal of Skills Development*, *1*(1*)*, 68-86.

Almerich, G., Orellana, N., Suarez-Rodríguez, J., & Díaz García, I. (2019). Teachers' information and

communication technology competences: A structural approach. *Computers & Education*, 100, 110–125.

Ananiadou, K., & Claro, M. (2009). *21st century skills and competences for new millennium learners in OECD Countries.* OECD Publishing.

Astuti, A. (2019). *Preparing 21st Century Teachers: Implementation of 4C Character's Pre-service Teacher through Teaching Practice.* IOP Publishing.

Barber, M., & Mourshed, M. (2017). *How the world's best-performing school systems come out on top.* McKinsey & Company.

Bedir, H. (2019). Developing a framework for the integration of 21st-century learning and innovation skills into pre-service ELT teachers' practicum. *International Online Journal of Education and Teaching (IOJET), 6*(4). 828-843.

Campbell, R., Pound, P., Pope, C., Britten, N., Pill, R., Morgan, M., & Donovan, J. (2003). Evaluating meta-ethnography: A synthesis of qualitative research on lay experiences of diabetes and diabetes care. *Social Science & Medicine, 56*(4), 671-684.

Cobo, C. (2018). Skills for innovation: envisioning an education that prepares for the changing world. *The Curriculum Journal, 24*(1)**,** 67-85.

Cochran-Smith, M., & Lytle, S. (2016). The teacher research movement: A decade later. *Educational Researcher, 28*(7), 15-25.

Critical Appraisal Skills Program. (2018). CASP Qualitative Checklist. https://casp-uk.net/wp-content/%20uploads/2018/01/CASP-Qualitative-Checklist-2018.pdf

Darling-Hammond, L., & Bransford, J. (2018*). Preparing teachers for a changing world: What teachers should learn and be able to do*. Jossey-Bass.

Desveaux, D., & Guo, L. (2016). *Educating for global citizenship: A practical guide for Canadian schools.* UNICEF Canada.

Durgesh, G. (2020). Singapore's teacher education model for the 21st Century (TE21). In F. M. Reimers (Ed.), *Implementing deeper learning and 21st education reforms* (pp. 59–77). Springer Nature.

Engen, B. K., Hilde, T., & Mifsud, L. (2018). Guidelines and regulations for teaching digital competence in schools and teacher education: A weak link*? Nordic Journal of Digital Literacy, 10*, 69–83.

Erdem, C. (2019). *Introduction to 21st century skills and education*. Afyon Kocatepe University.

Goddard, J. T. (2018). Redesign or rearrangement? The intensification of teacher education and the recognition of equity, diversity, and internationalization. In Y. Hébert & A. Abdi (Eds.), *The intensification of international education* (pp. 121-134). Sense.

González-Pérez, L.I., & Ramírez-Montoya, M.S. (2022). Components of education 4.0 in 21st century skills frameworks: Systematic review. *Sustainability*, *14*(3), 1493.

Guo-Brennan, L. (2022). Preparing teachers to educate for 21st Century global citizenship: Envisioning and enacting article. *Journal of Global Citizenship & Equity Education*, *4*(1), 1-23.

Häkkinen, P., Järvelä, S., Mäkitalo-Siegl, K., Ahonen, A., Näykki, P., & Valtonen, T. (2018). Preparing teacher-students for twenty-first-century learning practices (PREP 21): A framework for enhancing collaborative problem-solving and strategic learning skills. Teachers and Teaching: *Theory and Practice*, *23*(1), 25-41.

Hannes, K., Raes, E., Vangenechten, K., et al. (2013). Experiences from employees with team learning in a vocational learning or work setting: A systematic review of qualitative evidence. *Educational Research Review*, *10*, 116–132.

Horváth-Csikós, G., & Cseh Papp, I. C. (2021). Educational and economic aspects of mentoring how mentoring can contribute to the development of soft skills. *GiLE Journal of Skills Development*, *1*(1), 2732-3781.

Janssen, J., Stoyanov, S; Ferrari, A; Punie, Y; Pannekeet, K; & Sloep, P. (2018). Experts' views on digital competence: Commonalities and differences. *Computers & Education, 68,* 473-481.

Johnson, C. E., & Templeton, R. A. (2011). Preparing teachers for the 21st Century: A renaissance. In G. Wan & D.M Gut (Eds.), *Bringing Schools into the 21st Century, Explorations of Educational Purpose* (pp. 113-136). Springer.

Joynes, C., Rossignoli, S., & Amonoo-Kuofi, E. F. (2019). 21st Century Skills: *Evidence of issues in definition, demand and delivery for development contexts* (K4D Helpdesk Report). Institute of Development Studies.

Karakoyun, F., & Lindberg, O. (2020). Pre-service teachers' views about the twenty-first- century skills: A qualitative survey study in Turkey and Sweden. *Education and Information Technologies, 25*, 2353–2369.

Karasantik, Y., & Ayaz, M. A. (2019). Equipped or not? Investigating pre-service teachers' 21st-century skills. *Asia Pacific Journal of Education*, 1-18.

Kay, R.H. (2016). Evaluating strategies used to incorporate technology into preservice education: A review of the literature. *Journal of Research on Technology in Education, 38*(4), 383-408.

Kim, S., Raza, M., & Seidman, E. (2019). Improving 21st-century teaching skills: The key to effective 21st-century learners. *Research in Comparative & International Education, 14*(1), 99–117.

Levy, F., & Murnane, R. J. (2019). *The new division of labor: How computers are creating the next job market.* Princetown University Press.

Marchionini, G., & White, R. (2019). Find what you need and understand what you find. *International Journal of Human-Computer Interaction, 23*(3), 205–237.

McGarr, O., & McDonagh, A. (2020). Exploring the digital competence of pre-service teachers on entry onto an initial teacher education program in Ireland. *Irish Educational Studies, 1,* 1–14.

Mengual-Andres, S., Roig-Vila, R., & Mira, J. B. (2018). Delphi study for the design and validation of a questionnaire about digital competences in higher education. *International Journal of Educational Technology in Higher Education, 13*(1), 1-11.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2019). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement, *PLoS Medicine, 6*(7), e1000097.

Ng, W. (2022). Can we teach digital natives digital literacy? *Computers & Education, 59*, 1065-1078.

Noblit, G. W., & Hare, R. D. (1988). *Meta-ethnography: Synthesizing qualitative studies*. Newbury Park.

Ololube, N. P. (2016). *Teachers' instructional material utilization competencies in secondary schools in sub-Saharan Africa: Professional and non-professional teachers' perspective*. Conference proceedings of the 6th International Educational Technology Conference EMU, 19-21 April 2006 North Cyprus.

Önür, Z., & Kozikoğlu, I. (2020). The relationship between 21st-century learning skills and educational technology competencies of secondary school students. *Kuramsal Eğitimbilim Dergisi (Journal of Theoretical Educational Science)*, *13*(1), 65-77.

Osman, K., Tuan Soh, T. M., & Arsad, N. M. (2010). Development and validation of the Malaysian 21stcentury skills instrument (M-21CSI) for science students. *Procedia -Social and Behavioral Sciences, 9,* 599–603.

Reimer, K., & McLean, L. (2019). Conceptual clarity and connections: Global education and teacher candidates. *Canadian Journal of Education, 32*(4)*,* 903-926.

Schuiz, A. (2019). *Collected papers 1.* Martinus Nijhoff.

Sears, A., & Hughes, A. (2017). Citizenship: Education or indoctrination? *Citizenship Teaching and Learning, 2*(1), 3-17.

Shultz, L., Abdi, A., & Richardson, G. (2017). *Global citizenship education in postsecondary institutions: Theories, practices, policies.* Peter Lang.

Silva, E. (2019). Measuring Skills for 21st Century Learning. *The Phi Delta Kappan*, *90*, 630-634.

Singh, P. M., Singh, S. J., Acharya, S., & Rachh, H. (2020). *21st Century Skills.* Shahdara.

Starkey, L. (2019). Evaluating learning in the 21st Century: A digital age learning matrix. *Technology, Pedagogy, and Education, 20*(1), 19–39.

Subramaniam, I. (2018). Teacher's perception of their readiness in integrating soft skills in teaching and learning. *IOSR Journal of Research & Method in Education, 2*(5), 19–29.

Suh, J., Matson, K., Seshaiyer, P., Jamieson, S., & Tate, H. (2021) Mathematical modeling as a catalyst for equitable mathematics instruction: Preparing teachers and young learners with 21st Century Skills. *Mathematics*, *9*, 162. https://doi.org/10.3390/math9020162

Sykes, G. (2018). Cultivating teacher quality: a brief for professional standards. In: Hess F, Rotherham A, Walsh K (eds.), *A qualified teacher in every classroom*? (pp. 177-200). Harvard Education Press.

Tay, E. G. (2019). Preparing teachers for the 21st century. *AsTEN Journal of Teacher Education, 1*(1), 1-7.

Teo, T., Unwin, S., Scherer, R., & Gardiner, V. (2021). Initial teacher training for twenty- first-century skills in the Fourth Industrial Revolution (IR 4.0): A scoping review. *Computers & Education, 17*, 104-223.

Toibazarov, D. B., Seitova, S.M., Tasbolatova, R., Omarov, Z.A., & Ibrayeva, S.N. (2022). The role of applied problems in the training of future mathematics teachers in the 21st century. *Thinking Skills and Creativity, 42*, 100-945.

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development, 65*(3), 577. https://doi.org/10.1007/s11423-016-9492-z

Trilling, B., Fadel, C., & Partnership for 21stCentury Skills. (2009). *21stcentury skills: Learning for life in our times.* Jossey-Bass.

Urbani, J. M., Roshandel, S., Michaels, R., & Truesdell, E. (2022). *Developing and modeling 21st Century skills with preservice teachers.* Teachers Education Quarterly Fall.

Van de Oudeweetering, K., &Voogt, J. (2018). Teachers' conceptualization and enactment of twenty-first-century competencies: Exploring dimensions for new curricula. *The Curriculum Journal, 29*(1), 116–133.

Van Laar, E., van Deursen, A, J. A. M., van Dijk; J. A. G. M., & de Haan, J. (2020). Determinants of 21st-century Skills and 21st-century digital skills for workers: A systematic literature review. *SAGE Open, 10*, 1–14. https://doi.org/10.1177/2158244019900176

Wang, Q. (2019). Using online shared workspaces to support group collaborative learning. *Computers & Education, 55*(3), 1270–1276.

Weber, N., Evans, M., MacDonald, A., & Ingram, L. A. (2018). Educating for the global dimension of citizenship in Canadian schools: A snapshot of teachers' understandings and practices. *Education Review, 3*(2), 12-13.

Whitaker, T. (2017). *What great teachers do differently: 14 things that matter most*? Eye on Education.

Yan, C., & He, C. (2018). Transforming the existing model of teaching practicum: A study of Chinese EFL student teachers' perceptions. *Journal of Education for Teaching, 36(1*), 57-73.

Yeigh, T., & Lynch, D. (2018). Reforming initial teacher education: A call for innovation. *Australasian Journal of Teacher Education, 42*(12), 112–127.