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Mapping 21st Century Teaching Competencies: As Coping Review of Key Skills for Educators

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Abstract

The development of 21st-century teaching competences is essential for creating productive learning environments in the quickly changing educational world. Teaching competencies face a number of obstacles and constraints, including the fast changing nature of the IR 4.0 era. In order to close the knowledge gap, this systematic study looks at these competences as they are now. This research reviews recent academic literature on teachers' skills, aiming to understand transformative potential, challenges, and dynamic patterns in supporting accessible, egalitarian, and high-quality education in the 21st century. Twenty four peer-reviewed publications were methodically chosen and examined using the PRISMA approach. Three main themes emerged from the review: digital competence and technology in education, pedagogical competence and teacher professional development and 21st century skills and innovative teaching methods. The results show that even if integrating digital resources has advanced significantly, ongoing professional development is still vital to improve pedagogical abilities. Additionally, cutting-edge teaching strategies like project-based learning and STEM integration are crucial for giving children the skills they will need in the future. This review highlights the significance of a comprehensive approach to teacher preparation and offers recommendations.

Keywords: 21st Century Teaching Skills, Teaching Competencies, Scoping Review, Teachers' Ability, Systematic Literature Review

Introduction

The 21st century has brought about substantial changes to the job of teachers, including the need to redefine teaching competencies with consideration of the quickly changing context (Kosasih et al., 2022). The vast amount of information, the integration of new technology, and the trend towards a globalized society have all combined to rethink educational paradigms (Ratten, 2023). Today's teachers are expected to be more than just information providers; they must also help students learn by helping them develop into critical thinkers, problem solvers, and lifelong learners (Todorescu et al., 2015). This paradigm change necessitates a

thorough comprehension and the acquisition of new competences that are in line with the expectations of modern education.

The integration of critical abilities, pedagogical adaptation, and digital competency are the three main obstacles that teachers see in implementing 21st-century teaching competencies. Teachers in the Patikul West District of public elementary schools were the subjects of a study that showed that although they were highly competent in life and career skills, they felt that they needed more assistance and training in information, media, and technological abilities. Despite their dedication to include 21st-century skills into their teaching, teachers frequently feel unprepared to use digital tools in the classroom, as evidenced by this gap (Amdad & Asiri, 2024).

The aim of this research is to perform a thorough review of the most recent academic literature in order to clarify the transformative potential, challenges, and dynamic patterns in the area of teachers' skills. By investigating how teaching competencies education may effectively support accessible, egalitarian, and high-quality education in the twenty-first century, this review seeks to further the continuing discussion on the subject.

The Importance of the Study

In order to identify gaps and topics for additional research, a systematic literature evaluation on 21st-century teaching competencies is crucial as it aids in the organisation and clarification of current research. It provides insightful information that may be used to enhance teacher preparation programs and educational policies to better suit the needs of contemporary classrooms. In order to provide a baseline for improvement, this assessment evaluates how well the existing set of teaching abilities addresses issues like critical thinking and technological integration (Suherman et al., 2022). Additionally, by emphasising best practices and critical competencies for 21st-century student success, it can enhance teacher professional development (Dhakal, 2023).

This research is important because it focuses on equipping students with critical 21st-century skills like creativity, communication, and problem-solving, which are essential for success in today’s world. It also helps improve teaching by identifying key competencies teachers need to support student learning. The research can guide policy changes to better align teacher training and school curricula with modern needs, helping schools create more innovative learning environments. Overall, it aims to enhance education quality and prepare students for future challenges.

Significant of the Study

A systematic literature review on 21st-century teaching competencies is significant in education because it provides a comprehensive understanding of how teaching practices must evolve to meet contemporary demands. In today's digital and globalized world, teachers need to integrate critical thinking, creativity, communication, and collaboration into their pedagogical approach (Battelle for Kids, 2019). This research helps educational institutions ensure that their training programs equip teachers with the necessary skills to foster these abilities in students. By systematically reviewing existing studies, the research identifies key trends and gaps, enabling policymakers and educational leaders to develop more effective curricula and professional development programs.

Moreover, such a review plays a vital role in bridging the gap between theoretical frameworks and classroom practices. For instance, the rapid adoption of digital tools in education necessitates that teachers be proficient in technology integration, which is a core aspect of 21st-century competencies (Dhakal, 2023). By synthesizing evidence on how well educators are equipped with these competencies, the research not only provides insights into current shortcomings but also sets the stage for future educational innovations. This ensures that schools are better prepared to support both teachers and students in thriving within modern educational environments.

The Evolving Role of Teachers: Embracing 21st-Century Competencies

The present day teacher is expected to possess competencies that go beyond traditional subject matter expertise and pedagogical skills. In addition to addressing students' different needs, modern teachers must be skilled at incorporating technology into their lesson plans and creating a collaborative, inclusive learning atmosphere in the classroom (Noor, 2019; Sagita & Nisa, 2019). Effective teaching now includes developing digital literacy, encouraging critical thinking, and involving students through creative instructional tactics (Damanik & Widodo, 2024). Teachers also need to show that they are committed to lifelong learning and are continuously developing professionally in order to be able to adapt to the ever-changing landscape of education.

In this environment, concentrating on 21st-century teaching competencies is an essential attempt to improve the quality of education rather than just an academic one. Educational stakeholders can better support teachers in their professional progress and eventually enhance student outcomes by looking at and defining these qualities (Damanik & Widodo, 2024). This article examines the 21st-century key competencies for teachers, emphasizing the abilities and qualities required to create a stimulating, dynamic, and productive learning environment. This study attempts to add to the continuing conversation about teacher professional development in an increasingly linked and complicated world and educational reform through a thorough investigation.

To effectively educate pupils for the difficulties of modern society, teachers in the twenty-first century need to acquire a varied range of competences. Digital competency is a crucial element that includes teaching students how to apply various technologies for collaborative learning and using them for instructional objectives (Maghfiroh et al., 2023). Only a small portion of aspiring teachers who had their digital skills evaluated in a recent study were able to achieve advanced levels, underscoring the necessity of teacher preparation programs.

With a move towards student-centered learning environments that encourage collaborative and reflective thinking, pedagogical skills are equally essential (Kausar & Ajmal, 2024). According to Kausar & Ajmal, (2024), educators need to modify their methods in order to help kids develop self-worth and general wellbeing. Furthermore, it is imperative to incorporate critical 21st-century competencies including communication, problem-solving, creativity, and teamwork(Rajaram, 2021). Theoretical knowledge in these areas is imparted via teacher education programs, but there is still a large gap in practical application, which calls for a review of these programs.

Method

Identification

There are three main stages to the systematic review procedure that was used to choose pertinent papers for this report. Finding keywords and looking up comparable terms in thesauruses, dictionaries, encyclopaedias, and previous research is the first step in the process. After identifying the relevant keywords, search terms are created for Scopus and Web of Science (see Table 1). In this first stage of the systematic review, 373 papers were successfully retrieved from both databases by the present study.

Table 1

The search string

Scopus	TITLE-ABS-KEY(("teaching competenc*" OR "pedagogi* competenc*" OR "teaching abilit*" OR "pedagogi* abilit*" OR "teaching skill*" OR "pedagogi* skill*") AND ("twenty first centur*" OR "21st centur*" OR PAK21)) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2023)) AND (LIMIT-TO (LANGUAGE,"English"))
Wos	TS= (("teaching competenc*" OR "pedagogi* competenc*" OR "teaching abilit*" OR "pedagogi* abilit*" OR "teaching skill*" OR "pedagogi* skill*") AND ("twenty first centur*" OR "21st centur*" OR pak21)) and Preprint Citation Index (Exclude – Database) and Open Access and 2023 or 2022 or 2021 or 2020 or 2019 (Publication Years) and Article (Document Types) and English (Languages)

Screening

In the screening process, information that is in line with the predetermined research question(s) is identified by carefully examining the assortment of potentially pertinent research items. During this stage, content-related criteria are frequently used, such as the application of 21st century teaching competency in education. In this step, duplicate papers are methodically removed. 297 publications were rejected in the first screening phase. In the second phase, 76 papers were evaluated based on specific inclusion and exclusion criteria shown in Table 2. The principal criterion applied was the review of literature, or research articles, which functioned as the principal source of actionable suggestions. Reviews, meta-synthesis, meta-analyses, monographs, book series, chapters, and conference proceedings that were left out of the most current study are all covered by this criterion. Furthermore, only English-language articles were considered for assessment, and it's important to remember that the plan was limited to the years 2019 through 2023. Duplication rules led to the rejection of 16 papers in total.

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2019 to 2023	< 2019
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

Eligibility

An assortment of sixty articles was put together for the third step, which is known as eligibility. To ensure compliance with inclusion criteria and consistency with current research aims, a thorough evaluation of all article titles and important content was carried out at this point. As a result, 36 papers were disregarded because they were irrelevant to the subject, had no noteworthy titles, contained abstracts that had nothing to do with the goals of the study, or were unsupported by empirical data publications that did not have full-text access. Finally, 24 papers are left for additional analysis (see Figure 1).

Data Abstraction and Analysis

One of the assessment procedures in this study was an integrative analysis, which looked at and synthesized a range of research designs (quantitative approaches). The competent study's objective was to pinpoint pertinent subjects and subtopics. The initial phase of the theme's development was the data collection phase. The way the writers carefully examined a set of 24 publications for claims or information pertinent to the subjects of the present investigation is depicted in Figure 1. The authors next assessed the important recent research on teaching competencies for the twenty-first century. Investigations are being conducted into the research findings and the methods applied in all studies. The author then worked with other co-authors to create themes based on the data in the background of this study. Throughout the data analysis process, observations, opinions, puzzles, and other ideas pertinent to the interpretation of the data were recorded in a log. In order to determine whether the theme design process was inconsistent in any way, the writers finally compared the outcomes. It's important to note that the authors debate any differences in opinion among the notions with one another.

A log was kept throughout the data analysis process to document any analyses, viewpoints, conundrums, or other ideas that would be important to the interpretation of the data. The author compared the results and then searched for differences in the theme design procedure. It is important to remember that any conceptual discrepancies are explained by the writers. Final adjustments were made to the generated themes to preserve consistency. In order to assess the authenticity of the issues, two experts carried out the analytical selection. When the domain is specified, the expert review process finds it easier to ensure that each subtheme is unique, significant, and pertinent.

Quality of Assessment / Appraisal of Quality

Eventually, the generated themes were adjusted to guarantee coherence. Two experts in (focussing on teachers' competencies) conducted the analytical selection to ascertain the veracity of the challenges. By establishing the domain validity, the expert review phase guarantees each subtheme's significance, clarity, and suitability.

Two experts have been chosen to review and validate the 24 articles. This study used the Critical Appraisal Skills Program (CASP) checklist which has eight criteria (see Table 3). Quality appraisals were carried out by qualified experts who have more than 10 years of work experience in online learning for the educational institutions. The checklist is used as a guideline for evaluating the quality of studies to evaluate various sorts of evidence critically (Long et al., 2020). There are three indicators for the quality appraisal which is excellent, good and moderate. Each article was evaluated for its quality in terms of clear statement of the research aims, relevance of its methods and research design, recruitment of appropriate strategy, data collection, data analysis, clear statement findings, and the value of the research which are critically examined as shown in Table 3. Lastly, the 24 articles were reviewed in Table 3 after quality appraisal.

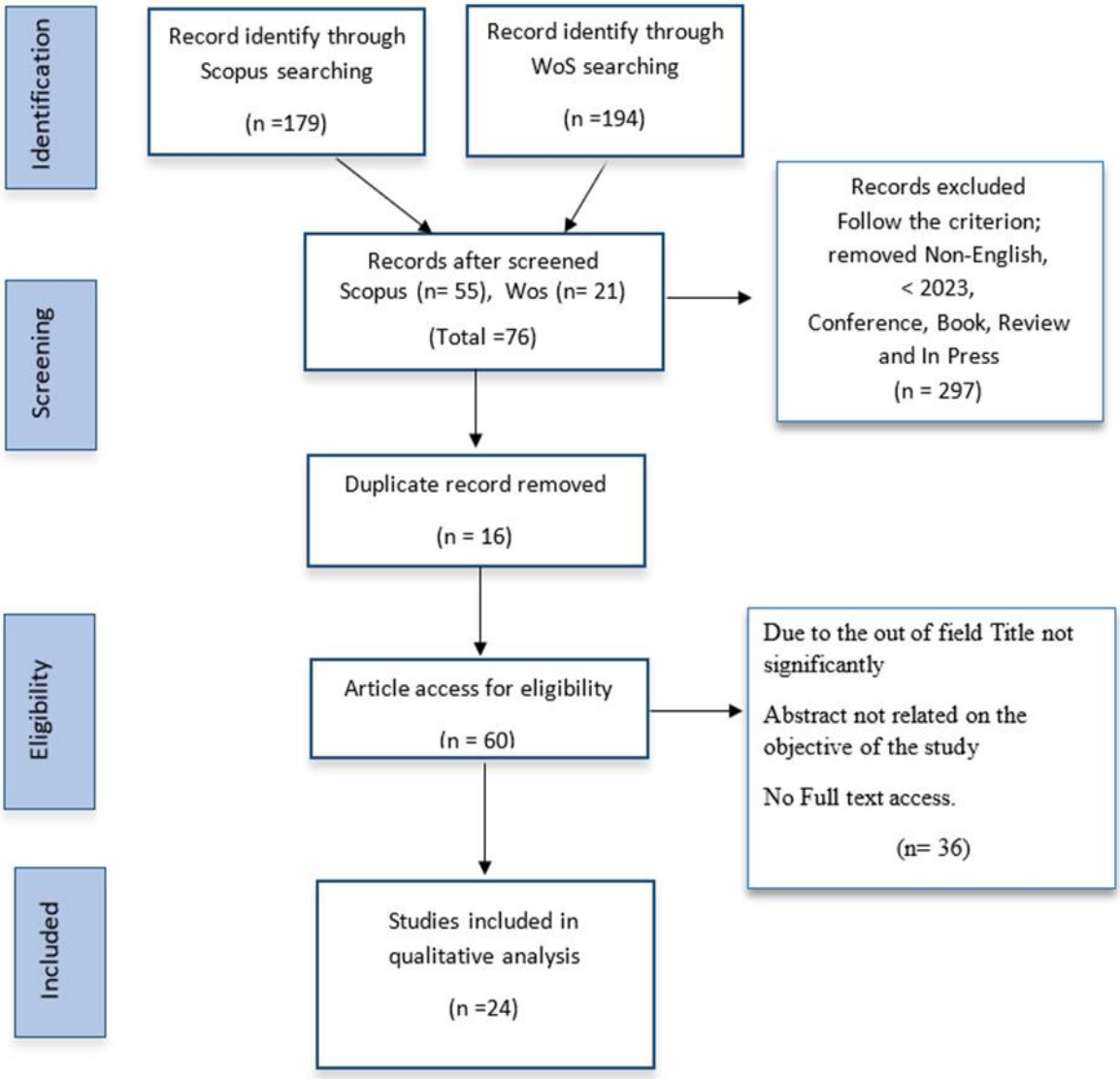

Figure 1: Flow diagram of the proposed searching study (Page et al., 2021)

Research Findings

The review of 21st century teaching competency highlights its revolutionary which is numerous regional studies demonstrate how the needs for teacher preparation in the twenty-first century are changing. Teachers possess excellent technical and pedagogical skills, but they also struggle with digital literacy and novel approaches like STEM integration and project-based learning (PjBL). Obstacles encompass insufficient resources, gender inequality, and institutional impediments. Today's teachers need to be creative, collaborative, and communicative in addition to having improved pedagogical training and ongoing professional development opportunities. The emphasis of recommendations is on updated curricula and focused training programmes to ensure that teachers are ready for the needs of the 21st century classroom and can provide students with the necessary skills. Teachers will be more equipped to create a dynamic and engaging learning environment if these criteria are met. . All articles were categorised based on three main themes, which are digital competence and technology in education (4), pedagogical competence and teacher professional development (8) and 21st century skills and innovative teaching methods (12) (Tab. 4).

TABLE 3

The Research Article Finding Based On The Proposed Searching Criterion

Theme 1: Digital Competence and Technology in Education

Authors	Title	Journal	Methodology	Finding and Advantages
(Hurtado-Mazeyra et al., 2022)	Digital competencies of Peruvian teachers in basic education	Frontier	Quantitative approach, non-experimental comparative descriptive design, non-probabilistic purposeful sampling, DigCompEdu Check-In instrument.	Most teachers possess an Integrator competence level (B1), followed by Expert (B2) and Explorer (A2); low percentages in advanced leadership levels (Leader and Pioneer).
(Miço & Cungu, 2022)	The Need for Digital Education in the Teaching Profession: A Path Toward Using the European Digital Competence Framework in Albania	Education	Online survey	Identified a need for acquiring digital knowledge among teachers and highlighted deficiencies in teacher training and infrastructure.resources.

(Corporan et al., 2020).	Perception of teachers on collaborative tools knowledge level mediated by ict and their experience with students	International Journal of Emerging Technologies in Learning (iJET)	Mixed model, questionnaire divided into demographic aspects, knowledge on collaborative tools, and experiences on collaborative work	Teachers require better training on collaborative methodologies and tools mediated by ICT; digital gap favoring male teachers.
(Gómez-Trigueros & De Aldecoa, 2021)	The digital gender gap in teacher education: The TPACK framework for the 21st century	Investigation in Health, Psycology and education	Exploratory and descriptive study, validated questionnaires and rubric, data collected over three academic years.	Female participants have poorer self-perception and lower predisposition towards technologies compared to men.

Theme 2: Pedagogical competence and teacher professional Development

Authors	Title	Journal	Methodology	Finding and Advantages
(Sprott, 2019)	Factors that foster and deter advanced teachers' professional development	Teaching and teacher education	Narrative study.	Teachers experienced growth through student collaboration, travel, learning with challenging academics, professional relationships, and working outside education.
(Fernández-Cruz & Rodríguez-Legendre, 2022)	The innovation competence profile of teachers in higher education institutions	Innovations in education and teaching internasional	Comparative study, questionnaire.	Identified varying levels of innovation skills among teachers. The findings will aid in designing training policies to improve innovation competence. Advantages: Provides a framework for assessing and improving innovation competence among university teachers.

(Kurniawan et al., 2023)	Education students' readiness as professional geographic teachers in the 21st century	International scientific electronic and education	Survey method, Confirmatory Factor Analysis (2nd CFA), Structural Equation Modeling (SEM).	Significant factors influencing readiness include respect for learner diversity and understanding of teaching materials. Recommendations for improving competencies include tutoring, lesson study, and integrating technology.
(Azrai et al., 2020)	Micro-teaching in the Digital Industrial Era 4.0: Necessary or not?	Educational research	Combination of quantitative and qualitative techniques, questionnaire, focus group discussions.	Found that lack of real classroom experience is a major obstacle. Micro-teaching offers several benefits but needs improvement. Advantages: Highlights the importance of real classroom experience and offers insights for improving micro-teaching.
(Azhar et al., 2022)	Implementation of the lesson study approach to develop teacher professionalism	Educational science	Observation, experiment, interview, statistical analysis, comparison, and synthesis.	Lesson Study approach improves professional competencies and teaching quality. Advantages: Provides evidence of the effectiveness of Lesson Study in professional development.
(Syamsuri & Muhsin, 2020)	Teacher orientation of post competence mapping in 21st century teaching systems	Innovation, creativity and change	Statistical analysis, questionnaire.	Identified gaps in pedagogical and professional competence. Advantages: Highlights areas needing improvement before teacher certification.
(Santaolalla et al., 2020)	Interdisciplinarity in teacher education: Evaluation of the effectiveness of an educational	Sustainability	Educational innovation project, Problem-Based Learning, empirical study.	Preservice teachers' abilities to teach have improved, and primary school pupils' understanding of social studies and mathematics

	innovation project			has advanced significantly.
(Umar et al., 2023)	A Correlational Study: Pedagogical and professional competence of physical education teachers in relation to the implementation of the Merdeka curriculum	Physical Education and Sport	Correlational study, quantitative approach, questionnaire, SPSS analysis.	Implementing the Merdeka Curriculum and pedagogical/professional competency are strongly correlated.

Theme 3: 21st Century skills and innovative teaching methods

Authors	Title	Journal	Methodology	Finding and Advantages
(Pratama et al., 2022)	Integration of STEM education in history learning	Evaluation and research in education	Qualitative approach, pupil's work samples, interviews, teacher journals.	Though at a lesser level, teachers were still able to incorporate historical thinking abilities and historical awareness. Effective improvement of these talents requires training.
(Erten, 2022)	Analyzing Vocational High Schools Within the 21st Century Learner and Teacher skills Spectrum	Education and science	Qualitative and quantitative research methods	Both teachers and students employ 21st-century skills to varying degrees, with learners utilising their cognitive and inventive abilities more frequently. Considerable disparities were discovered depending on factors such as mother education and gender.
(Kim et al., 2019)	Improving 21st-century teaching	Comparative and	Teacher Instructional	TIPPS can be applied to reflective practice,

	skills: The key to effective 21st-century learners	Internasional education	Practices and Processes System (TIPPS).	continuous development, and instructor feedback, resulting in improved 21st-century teaching and learning capabilities.
(Burai & Kardum, 2022)	An Analysis of Learning Outcomes Achieved through Pedagogical Competencies Acquisition Programme in the Republic of Croatia	International journal and instruction	Qualitative and quantitative research methods.	According to the analysis, every teacher must participate in a unified national program to guarantee that they have acquired the essential pedagogical competences.
(Hamzeh et al., 2022)	Twenty-first-century skills acquired by mathematics teachers: School principals' perspectives	Educational Science	Questionnaires on personal, communication, technical, and teaching skills	The degree of skill develops varied, and gender did not significantly affect these variances. Making use of these abilities can enhance the educational process.
(Zamora & Zamora, 2022)	21st Century Teaching Skills and Teaching Standards Competence Level of Teacher	Learning, teaching and Educational Research	Surveys, t-Test, ANOVA, multiple linear regression	Graduates demonstrated high to extremely high levels of competency and skills. It's advised to have regular conversations and meetings to discuss issues and guarantee the acquisition of 21st-century teaching techniques.
(Haatainen & Aksela, 2021)	Project-based learning in integrated science education: Active teachers' perceptions and practices	Math, Science and Technology Education	Qualitative-led survey, case study	PBL is thought to be advantageous, but teachers require assistance in putting it into practice. PBL pedagogical competency can be improved through collaborative learning.
(Rusydiyah et al., 2021)	Stem learning environment: Perceptions and	Pendidika IPA Indonesia	Qualitative approach,	Considerable improvement in perspectives and

	implementation skills in prospective science teachers		descriptive statistical analysis	practical abilities related to STEM education following internships. The design of curricula should prioritise professional and pedagogical courses.
(Almerich et al., 2020)	21st-century competences: The relation of ICT competences with higher-order thinking capacities and teamwork competences in university students	Computer Assissted Learning	Correlational study, questionnaires	ICT competencies and high-skill competencies have a positive association. The other competency sets are more closely tied to pedagogical competencies.
(Bozkurt, 2021)	Evaluation of Social Studies Teacher Training Program in Terms of 21st Century Skills	Education	Survey design, phenomenology pattern	While social studies teacher preparation programs fall short in terms of global and digital teaching competencies, they excel in the development of cooperation and communication skills. 21st-century talents should be modelled in educational settings.
(Ramli et al., 2020)	The investigation of teaching style: Electrical engineering teachers' views in vocational high schools	Materials Scienc and engineering	Survey research method, interviews, questionnaires	The traditional teaching methods that teachers employ are out of step with 21st-century learning. It is advised to use a variety of student-centered teaching philosophies to boost involvement.
(Md Yunus et al., 2019)	Teaching writing in the 21st century: An overview of theories and practices	Innovation, creativity and change	Theoretical overview	Essay writing abilities can be improved by putting an emphasis on originality, teamwork, and communication. If we want to prevent unemployment in the Fourth Industrial Revolution, we must prepare for it.

Summary
Technology in the classroom and digital competency are essential for 21st-century abilities. A study conducted in Peru revealed that while most eductors had fundamental digital capabilities, they fall short in advanced leadership competencies. The pandemic in Albania brought attention to the need for improved teacher infrastructure and digital training. Secondary teachers in the Dominican Republic need more training in ICT tools for group projects, and there is a documented digital divide between male and female teachers. The necessity for gender-sensitive digital training is highlighted by the fact that female instructors in Spain report being less digitally competent than their male counterparts. In order to increase teachers' digital skills globally, these findings highlight the significance of better regulations, infrastructure, and focused professional development in the field of digital education.

Diverse demands and strategies are revealed when 21st-century teaching competencies are investigated. Despite hierarchical constraints, advanced instructors develop via multidisciplinary positions, worldwide experiences, and collaborative professional development. Higher education instructors in Bolivia, Mexico, and Spain differ in their capacity for innovation, necessitating specialised training. Indonesian geography teacher candidates place a strong emphasis on topic mastery and respecting learner variety. In the digital age, realistic classroom simulations are a challenge for microteaching. Lesson Study uses reflective practice to improve the quality of instruction. The mapping of teacher competency in South Sulawesi reveals deficiencies in pedagogical skills. Multidisciplinary projects enhance the learning of primary pupils and preservice teachers. The professional and pedagogical abilities of physical education instructors are critical to the achievement of the Merdeka Curriculum.

Education must change in the twenty-first century from imparting content-focused knowledge to fostering students' critical thinking and inventive abilities. Teaching methods are improved and historical thinking is encouraged when STEM (science, technology, engineering, and mathematics) is incorporated into disciplines like history. According to studies conducted in Turkey, both teachers and students in vocational schools use 21st-century skills, but they lack flexibility and proper facilities. On the other hand, studies conducted in Ghana, India, and Uganda highlight the necessity of context-specific teacher preparation to improve the calibre of education. Project-based learning (PBL) is becoming increasingly popular worldwide, which highlights how well it fosters teamwork and problem-solving abilities. In the end, cultivating these competencies and preparing children for future problems requires ongoing teacher training and revised curricula.

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