

Pre-Service Teachers' Readiness in the 21st Century Instructional Practices

Marina W. Dacaca-Acerit

Isabela State University-Echague Campus, College of Education, Isabela, Philippines
E-mail: marinaacerit.isu@gmail.com

KEYWORDS Classroom Innovation. Digital Literacy. Educational Preparation. Pedagogical Competence. Student-Centred Learning

ABSTRACT This study assessed the readiness of 203 pre-service teachers (PSTs) from the College of Education of Isabela State University to implement 21st century instructional practices. Using a descriptive-comparative research design, data were collected through a validated 50-item instrument completed by PSTs and their cooperating teachers (CTs). The study examined readiness across creativity, critical thinking, information, media, and technology skills (IMTS), communication, and collaboration, and analysed differences based on sex, academic program, and assessment source. Findings revealed that male PSTs reported higher readiness in creativity, critical thinking, and technology integration. Variations were also observed across academic programs, with technology- and performance-oriented programs demonstrating greater preparedness. CTs consistently rated PSTs higher than PSTs rated themselves, indicating a perceptual gap between perceived and observed competencies. The study concludes that curriculum-aligned experiential learning, mentorship, and reflective practice are essential for enhancing PSTs' readiness to effectively implement 21st century instructional practices.

INTRODUCTION

The demands of 21st century education continue to reshape how teacher education programs prepare future educators for real-world classroom challenges. In this evolving landscape, teachers are expected not only to master pedagogical theories but also to demonstrate competence in creativity, collaboration, communication, critical thinking, and digital literacy. These skills enable them to facilitate meaningful learning experiences in diverse and technology-enhanced environments.

In the Philippine context, Jaca and Castañeda (2025) found that pre-service teachers with strong collaboration, communication, and creativity skills tend to be more confident and effective during practice teaching. Their study underscores that these competencies serve as strong predictors of instructional readiness and classroom adaptability. Building on this evidence, the present study extends the scope of inquiry by including critical thinking and information, media, and technology skills (IMTS) as integral dimensions of 21st century instructional competence.

Globally, scholars emphasise that the role of teachers has evolved from being transmitters of knowledge to facilitators of learning who help students construct and apply knowledge in authentic contexts (Cem and Aydin 2025; Fitrah et al. 2025;

Osorio Vanegas et al. 2025). To succeed in this role, teachers must be able to integrate technology effectively and design learning experiences that promote inquiry, creativity, and collaboration. Moreover, they must possess the ability to organise knowledge, skills, and values within dynamic and digitally mediated environments (Majeed 2025; Yang and Du 2024).

The Organisation for Economic Co-operation and Development (OECD 2025) further highlights the importance of equipping teachers with holistic competencies like spanning disciplinary expertise, assessment literacy, digital proficiency, and global consciousness. These competencies allow teachers to transform information into meaningful knowledge, foster critical and creative thinking, and guide learners toward ethical and collaborative engagement in a complex world.

Within this context, the framework of the Partnership for 21st Century Learning (P21 2007) identifies five essential domains, that is, Creativity, Critical Thinking, Communication, Collaboration, and Information, Media and Technology Skills (IMTS), as foundations for 21st century education. Teacher Education Institutions (TEIs) play a pivotal role in developing these competencies among pre-service teachers (Bihasa et al. 2024; Carvajal et al. 2025; Olvido et al. 2024). At Isabela State University (ISU), the College of Education is com-

mitted to preparing globally competent, future-ready teachers capable of addressing the demands of modern classrooms.

Assessing pre-service teachers' readiness in applying 21st century instructional practices provide valuable insights for improving teacher preparation programs. By incorporating both self-assessment and cooperating teachers' evaluations, this study aims to offer a comprehensive understanding of how pre-service teachers are prepared to meet contemporary educational standards and classroom realities as national curricula need to change drastically to comply with the competences needed for the 21st century.

Review of Related Literature

The evolving demands of 21st century education have intensified the need for teachers capable of integrating creativity, critical thinking, collaboration, communication, and digital literacy into classroom practice (Bwembya et al. 2024; Haryaka et al. 2025; Khoso et al. 2025). These competencies are essential not only for knowledge transmission but also for cultivating learners' problem-solving abilities, innovation, and lifelong learning capacity.

Creativity and Critical Thinking

Creativity in teaching involves designing learning environments that foster innovation, flexible thinking, and student engagement. Simon and Nissim (2025) emphasise that instruction promoting creativity motivates learners and enhances their capacity to generate novel ideas, particularly in inquiry-driven and project-based contexts. Complementing creativity, critical thinking equips teachers to guide students in evaluating evidence, constructing reasoned judgments, and applying concepts to authentic situations (Tam and Tien 2024). Together, these competencies support higher-order thinking and enable educators to adapt instruction to meet diverse classroom needs.

However, as Kenett (2025) caution, high creative thinking does not automatically ensure effective problem-solving. This study of pre-service teachers (PSTs) revealed that while participants scored highly on fluency, flexibility, and elaboration, their performance in statistics problem-solving remained low. This finding underscores the necessity of integrating structured, problem-solv-

ing experiences within teacher education to ensure creative skills translate into practical instructional effectiveness.

Information, Media and Technology Skills (IMTS)

Digital literacy has become a cornerstone of contemporary teaching. Beyond tool usage, teachers must employ technology to facilitate collaboration, exploration, and content creation (Mahmud et al. 2025; Nancy 2024). The OECD (2025) emphasises that digital proficiency and data literacy are essential traits of future-ready educators. Recent systematic reviews highlight that readiness in educational technology encompasses technical, pedagogical, communicative, and ethical competencies (Osorio/ Vanegas et al. 2025).

In the Philippine context, teacher education programs increasingly equip PSTs with technological skills. Shen et al. (2025) found that PSTs exhibit strong self-efficacy in computer use, online communication, and self-directed learning. Similarly, Getenet et al. (2024) reported that Filipino PSTs frequently use technology in classroom tasks, though challenges remain in practical application, such as managing diverse learners and integrating tools during practicum. These findings highlight the need for teacher preparation programs to move beyond tool familiarity, emphasising sustained, contextualised application of 21st century skills. Kiryakova and Kozhuharova (2024) further note that pre-service training alone is insufficient, as continuous, scaffolded professional development and adoption of structured frameworks like Dig-CompEdu are critical for developing effective digital competencies.

Communication and Collaboration

Effective communication encompasses linguistic and interpersonal skills, shaping student engagement, motivation, and learning (Fadillah et al. 2025). Collaboration involves teamwork, shared decision-making, and reflective dialogue, fostering inclusive classroom environments (Iraola et al. 2024; Roy 2024). Structured collaborative practices, including peer feedback, co-planning, and reflective dialogue, have been shown to enhance instructional effectiveness (Santagata and Guarino 2012). These findings reinforce the P21 (2007) framework, which positions communication and

collaboration as central to learner-centred pedagogy. In the Philippine setting, Utami (2025) observed that PSTs generally demonstrate strong interpersonal and instructional skills but may encounter challenges in oral proficiency, aligning with current study results showing high self-assessed and cooperating teacher-evaluated readiness in communication.

Ravich (2024) further supports these observations, reporting that cooperating teachers rated PSTs as “very good” in adaptability, visionary thinking, collaboration, and risk-taking, though communication and professional modelling received lower ratings. Constraints such as limited mentoring time and restricted ICT resources were noted, highlighting the critical role of teacher education programs in scaffolding communication, digital collaboration, and mentorship.

Teacher Readiness for 21st Century Skills

Empirical evidence consistently links 21st century skills with teacher readiness. Fiel and Sermona (2024) found that PSTs demonstrating high creativity, communication, and collaboration are more professionally effective during practice teaching. In Philippine contexts, studies show that teacher education programs are successfully fostering PSTs’ confidence in technology integration, learner-centred instruction, and collaborative engagement (Oriol 2025; Rivera et al. 2025). Notably, the present study corroborates these findings, revealing that cooperating teachers often rate PSTs’ readiness higher than the PSTs’ self-assessment, particularly in creativity, technology use, communication, and collaboration. This discrepancy underscores the importance of mentoring, reflective practice, and structured experiential learning to bridge perception and observable instructional competence.

Collectively, literature and current findings affirm that Filipino pre-service teachers demonstrate strong readiness in the core domains of 21st century instruction. Nonetheless, deliberate strategies are required to ensure competencies, especially creative problem-solving, digital literacy, and communicative-collaborative skills, are fully operationalised in classroom practice. Teacher education programs should prioritise experiential learning, structured reflection, and scaffolded technology integration to prepare PSTs for the dynamic demands of contemporary classrooms.

Objectives of the Study

The objective of the study is to assess the readiness of pre-service teachers in 21st century instructional practices and to determine variations based on their profile and between their self-assessments and cooperating teachers’ evaluations. Specifically, it describes their profile in terms of sex and education program, determines their level of preparedness across creativity, critical thinking, information, media and technology skills, communication, and collaboration as both self-assessed and evaluated by cooperating teachers, and examines significant differences when grouped according to profile variables and between assessments. This study is important as it addresses the need to evaluate whether teacher education programs are effectively preparing future educators with essential 21st century skills required in modern, technology-driven classrooms. It provides evidence for identifying strengths and gaps in pre-service teacher preparation, thereby offering a strong basis for improving curriculum design, teacher training practices, and overall instructional readiness.

Specifically, the study aims to:

1. To describe the profile of pre-service teachers in terms of sex and education programs.
2. To determine the extent of preparedness of pre-service teachers in 21st century instructional practices, as self-assessed by the pre-service teachers and evaluated by their cooperating teachers, across the following domains:
 - a. Creativity
 - b. Critical Thinking
 - c. Information, Media and Technology Skills
 - d. Communication
 - e. Collaboration
3. To examine significant differences in the extent of preparedness of pre-service teachers in 21st century instructional practices:
 - a. When grouped according to profile variables
 - b. Between self-assessment and cooperating teachers’ assessment.

METHODOLOGY

Research Design

The study utilised a descriptive-comparative research design to assess the level of preparedness of pre-service teachers in 21st century instruc-

tional practices. This design was deemed appropriate as it allows for the systematic description and comparison of perceived competencies based on demographic and academic variables.

Participants

The respondents of the study were 203 pre-service teachers from the College of Education, Isabela State University, Echague Campus, who were undergoing their practice teaching during the academic year. The majority of the respondents are female with 162 respondents (79.80%) while the male with 41 respondents (20.20%). For the programs where they are enrolled, most of them are from Bachelor of Elementary Education (BEED) with 46 respondents (22.70%) and the program with least frequency is BSE-Mathematics with 21 respondents (10.30%). The other programs are Bachelor of Technical Livelihood Education (BTLED) with 31 respondents (15.30%), Bachelor of Physical Education (BPED) 37 (18.20%), Bachelor of Secondary Education (BSED) English with 22 respondents (10.80%), BSED Filipino with 22 respondents (10.80%), and BSED Social Science with 24 respondents (11.80%).

Their respective cooperating teachers also served as secondary respondents who evaluated the same set of competencies using a parallel instrument.

Research Instrument

The study used a specially developed instrument to assess pre-service teachers' readiness in 21st century instructional practices. It focused on five key domains of creativity, critical thinking, innovation, media and technology skills (IMTS), communication, and collaboration, all rooted in well-established 21st century learning frameworks and research to ensure the content was valid and relevant.

For instance, the creativity domain (items 1-10) was informed by P21 (2007) (Ibrahim et al. 2019; Li et al. 2022), while critical thinking (items 11-20) drew on P21 (2007) (Valtonen et al. 2021; Ibrahim et al. 2019). The IMTS domain (items 21-30) was guided by P21 (2007) (Cuhadar 2018; Li et al. 2022). Communication (items 31-40) was based on P21 (2007) (Tican and Deniz 2019; Urbani et al. 2017), and collaboration (items 41-50) was derived from P21 (2007) (Valtonen et al. 2021; Martinez 2022). Each domain included ten indicators, making a total of 50 items, which participants rated on a four-point

Likert scale with 1 - Not Prepared, 2 - Slightly Prepared, 3 - Prepared, and 4 - Very Prepared.

Two parallel versions of the questionnaire were used with one for pre-service teachers' self-assessment and another for evaluation by their cooperating teachers. The instrument underwent expert review and pilot testing, achieving a Cronbach's alpha of 0.92, which indicates excellent internal consistency. This thorough development process ensures the instrument reliably reflects pre-service teachers' competencies in 21st century instructional practices.

Data Analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS). Frequency and percentage were used to describe the respondents' profile. Weighted means determine the level of preparedness in each domain. Independent samples t-test assessed differences according to sex. One-way ANOVA examined differences across education programs. Paired samples t-test compared the self-assessment and cooperating teacher evaluations. The level of significance was set at 0.05 for all inferential analyses.

RESULTS AND DISCUSSION

Pre-Service Teachers' Preparedness in 21st Century Instructional Practices

The readiness of pre-service teachers (PSTs) in implementing the five areas of 21st century instructional practices of Creativity, Critical Thinking, Information, Media and Technology Skills (IMTS), Communication, and Collaboration, is presented in Table 1. The findings indicate that PSTs were generally very prepared across all dimensions, with mean scores ranging from 3.42 to 3.51 in their self-assessments and 3.41 to 3.59 in the evaluations of cooperating teachers. Collaboration obtained the highest mean in both groups (PSTs: 3.51; cooperating teachers: 3.59), followed by Communication (PSTs: 3.51; cooperating teachers: 3.56), indicating strong readiness in facilitating cooperative and interactive learning environments. Creativity received identical ratings from both PSTs and cooperating teachers (3.44), reflecting consistent perceptions of their ability to design innovative instructional strategies. IMTS showed slight-

Table 1: Pre-Service teachers' preparedness in 21st century instructional practices

<i>Domain mean</i>	<i>Pre-service teachers' mean Qualitative description</i>	<i>Qualitative description</i>	<i>Cooperating teachers'</i>
Creativity Very prepared	3.44	Very prepared	3.44
Critical Thinking Very prepared	3.42	Very prepared	3.41
Information, Media and Technology Skills (IMTS) Very prepared	3.43	Very prepared	3.50
Communication Very prepared	3.51	Very prepared	3.56
Collaboration Very prepared	3.51	Very prepared	3.59

ly higher ratings from cooperating teachers (3.50) than PSTs (3.43), suggesting that external observers perceived stronger technology integration skills than the PSTs' self-assessment. Meanwhile, Critical Thinking obtained the lowest but still very prepared ratings (PSTs: 3.42; cooperating teachers: 3.41), indicating that while PSTs demonstrate foundational competence in fostering analytical thinking, it remains the area needing further enhancement.

PSTs demonstrated strong readiness in creativity, as shown by their ability to encourage idea exploration, innovation, and the use of technology to support learning. This supports Morales and Baguio (2025), who reported strong creative fluency among Filipino PSTs, and Mat and Jamaludin (2024), who emphasised creativity as central to student-centred learning. These findings suggest that PSTs are prepared to design engaging, inquiry-based lessons that promote active learner participation. This implies that teacher education programs should continue strengthening opportunities for creative pedagogy through project-based learning, instructional design tasks, and authentic classroom simulations.

Readiness in critical thinking was also evident, particularly in PSTs' ability to guide learners in analysing information, evaluating evidence, and solving problems. This aligns with Wei et al. (2024) and Lamaro et al. (2024), who emphasised critical thinking as essential for developing learners' higher-order thinking and decision-making skills. However, Beencke (2024) cautioned that critical thinking skills alone may not ensure effective classroom application without contextualised practice. This implies that teacher education programs must integrate more authentic problem-solving tasks, case-based instruction, and classroom-based

practicum experiences to bridge the gap between theory and practice.

The positive ratings for IMTS indicate that PSTs are confident in integrating technology into instruction and supporting digital literacy development among learners. This finding is consistent with Rahimova (2024) and Regañon (2024), which highlight digital competence as a core requirement for 21st century educators. This implies the need for sustained exposure to digital pedagogy, educational technologies, and data-informed instruction to ensure that PSTs can use technology not only effectively but also pedagogically meaningfully.

Communication readiness was also rated highly, reflecting PSTs' ability to facilitate discussions, provide feedback, and engage learners effectively. This supports Davidson et al. (2024), who identified communication as a key determinant of effective teaching. However, Compton (2024) noted that limited mentoring and resources may constrain communication skill development during practicum experiences. This implies that structured mentoring systems, guided teaching practice, and reflective feedback mechanisms should be strengthened in teacher education programs.

Among all domains, collaboration received the highest rating, indicating that PSTs are well prepared to work effectively with peers, mentors, and other stakeholders. This supports Kamali and Javahery (2025), who found that collaboration is enhanced through peer feedback, shared planning, and reflective dialogue. Overall, the findings suggest that PSTs are generally well prepared for 21st century teaching. However, consistent with Darminto et al. (2025), these competencies must be reinforced through experiential learning and authentic teaching practice. Findings imply that

teacher education institutions should further strengthen practicum-based learning, structured mentoring, and technology-integrated pedagogy to ensure that PST readiness translates into sustained instructional effectiveness and improved learner outcomes in real classroom contexts.

Differences in the Extent of Preparedness of Pre-Service Teachers in 21st Century Instructional Practices

Differences Based on Sex

The analysis of gender differences in pre-service teachers' (PSTs) perceived readiness to implement 21st century instructional strategies across the domains of Creativity, Critical Thinking, Information, Media and Technology (IMT) Skills, Communication, and Collaboration is presented in Table 2, showing statistically significant differences between male and female PSTs, with males consistently obtaining higher mean scores across all domains. Specifically, males reported higher scores than females in Creativity ($M = 3.63$ vs. $F = 3.39$; $t = 3.12$, $p < 0.01$), Critical Thinking ($M = 3.63$ vs. $F = 3.36$; $t = 3.24$, $p < 0.01$), Information, Media and Technology Skills ($M = 3.65$ vs. $F = 3.37$; $t = 3.18$, $p < 0.01$), Communication ($M = 3.67$ vs. $F = 3.46$; $t = 2.45$, $p < 0.05$), and Collaboration ($M = 3.71$ vs. $F = 3.46$; $t = 3.07$, $p < 0.01$), indicating greater perceived preparedness among male PSTs to apply 21st century instructional practices across all measured competencies.

In the Creativity domain, male PSTs demonstrated significantly higher readiness in facilitating innovative, hands-on, self-expressive, and reflective learning experiences ($p = 0.04$ – 0.00), supporting Li et al. (2026) on stronger multi-perspective thinking among males, and Ajani (2024) on the need to translate creativity into practical instructional problem-solving. Similar patterns emerged in Critical Thinking, IMT Skills, and Communica-

tion, where males showed higher readiness in problem-solving, authentic instruction, technology integration, and communication practices ($p = 0.00$ – 0.05), consistent with findings on analytical reasoning (Amponsah et al. 2024; Budayasa and Rahaju 2025) and ICT confidence (Vallente et al. 2025).

In Collaboration, male PSTs also reported higher readiness in teamwork, collaborative learning, and use of collaborative technologies ($p = 0.00$ – 0.04), although this contrasts with Boy and Sava^oci (2024), who found stronger interpersonal coordination among females. Overall, findings suggest that gender differences in perceived readiness may be influenced by variations in confidence, exposure, and socio-cultural factors, highlighting the need for teacher education programs to strengthen equitable opportunities and targeted support to enhance female PSTs' 21st century instructional competencies.

Differences Based on Course

The analysis of pre-service teachers' (PSTs) 21st century readiness based on course enrollment, as shown in Table 3, indicates that course specialisation is significantly associated with variations in preparedness across the different domains, with the most notable differences observed in Creativity and Critical Thinking. Specifically, PSTs enrolled in BPED, BSED-Social Sciences, and BSED-Filipino obtained significant results in Creativity ($t = 3.12$, $p = 0.04$) and Critical Thinking ($t = 3.24$, $p = 0.02$), suggesting comparatively stronger readiness in higher-order thinking skills among these groups. In contrast, although these same programs recorded relatively high t -values in Information, Media and Technology Skills (IMTS) ($t = 3.18$, $p = 0.07$), Communication ($t = 2.45$, $p = 0.11$), and Collaboration ($t = 3.07$, $p = 0.18$), these were not statistically significant, indicating that differences across courses in these domains are not strong enough

Table 2: PTs differences in 21st century instructional practices: Extent of readiness by sex

Domains	Group means		<i>t</i> -value	<i>p</i> -value
	Male	Female		
Creativity	3.63	3.39	3.12	0.00*
Critical Thinking	3.63	3.36	3.24	0.00*
Information, Media and Technology Skills (IMTS)	3.65	3.37	3.18	0.00*
Communication	3.67	3.46	2.45	0.02*
Collaboration	3.71	3.46	3.07	0.00*

to be considered meaningful at the 0.05 level. Overall, the findings highlight that academic preparation and disciplinary focus appear to play a more pronounced role in shaping PSTs' development of creativity and critical thinking, while other 21st century skills may be more uniformly distributed across programs or require more consistent cross-disciplinary reinforcement.

In terms of Creativity, item-level results show that BPED students demonstrated the highest performance in generating new ideas, taking instructional risks, and reflecting on creative processes. Meanwhile, BSED-Social Sciences and BSED-English students showed stronger abilities in self-expression and fostering inclusive learning environments. This aligns with Marangio et al. (2024), who emphasised creativity as a key motivational and instructional driver in learning environments, and Li (2025), who highlighted reflective practice as essential for deep learning and professional growth. These findings suggest that arts-based and social science-oriented programs provide fertile ground for cultivating creative instructional capacity.

For Critical Thinking, BSED-Filipino students showed particularly strong performance in analysing and evaluating information, engaging in problem-solving, and facilitating academic discourse such as debates. This supports Boonchoo and Nokkaew (2025) and Rütli-Joy (2024), who argue that language-rich curricula strengthen analytical and evaluative reasoning. Collectively, the results suggest that language-based, arts-based, and social science programs offer meaningful contexts for developing creativity and critical thinking, reinforcing the importance of curriculum exposure in shaping instructional readiness.

Across IMTS, Communication, and Collaboration, similar trends were observed, with BPED, BSED-Filipino, BSED-Social Sciences, and BSED-English generally showing strong performance in digital literacy, content organisation, communication practices, and collaborative engagement. This aligns with Holm (2025) and Quraishi et al. (2024), who found that curriculum exposure is strongly linked to digital competence, as well as Nurzhanova et al. (2024) and OECD (2025), who identified digital literacy as a core attribute of effective 21st century teachers. However, findings from supervising cooperating teachers (Mugot and Sumbalan 2019) suggest that PSTs may sometimes under-

estimate their actual classroom competence, particularly in technology integration and collaboration. In essence, findings imply that course enrollment significantly influences 21st century readiness, highlighting the need for curriculum-specific strengthening strategies that further enhance digital pedagogy, collaboration, and reflective practice across all programs.

CONCLUSION

The findings of this study indicate that pre-service teachers generally demonstrate a high level of readiness in 21st century instructional practices, including creativity, critical thinking, information, media and technology skills, communication, and collaboration, reflecting strong foundational preparation for learner-centred and technology-integrated teaching. However, significant differences in readiness influenced by gender and course specialisation suggest that the development of these competencies is not uniform and may be shaped by differences in exposure, confidence, disciplinary training, and socio-cultural factors. While PSTs are broadly prepared to implement innovative and collaborative teaching strategies, the results also highlight the need to strengthen the transfer of these competencies from theoretical understanding to practical classroom application, particularly through authentic learning experiences, structured mentoring, and sustained exposure to digital and problem-solving activities. This study implies that teacher education institutions should therefore enhance curriculum design by integrating more experiential and practice-based learning opportunities, strengthening equitable support systems that address differences in learner background and confidence, and ensuring consistent development of 21st century pedagogical skills so that all pre-service teachers are equally equipped to translate readiness into effective and impactful classroom instruction.

RECOMMENDATIONS

This study recommends that teacher education institutions strengthen the development of pre-service teachers' 21st century instructional competencies by further integrating experiential, practice-based, and technology-enhanced learning opportunities across all programs. Specifically,

curricula should emphasise authentic classroom simulations, problem-based and inquiry-driven tasks, and sustained practicum experiences that allow pre-service teachers to apply creativity, critical thinking, IMT skills, communication, and collaboration in real teaching contexts. Structured and continuous mentoring should also be prioritised to bridge gaps between theoretical knowledge and actual classroom performance, with targeted support mechanisms designed to enhance confidence and instructional competence, particularly among groups showing comparatively lower readiness. In addition, programs should ensure equitable access to digital tools and learning resources while embedding reflective practice and collaborative learning structures that foster continuous professional growth. Future studies are encouraged to employ mixed-method and comparative research designs to further explore how pre-service teachers develop and apply 21st century instructional competencies across different contexts, and to examine the effectiveness of specific interventions such as enhanced practicum models, digital pedagogy training, and mentoring frameworks in strengthening teaching readiness and classroom performance.

REFERENCES

- Ajani OA 2024. Enhancing problem-solving skills among pre-service teachers in higher education: A systematic literature review. *Journal of Pedagogical Sociology and Psychology*, 6(2): 98-113.
- Amponsah KD, Awoniyi FC, Ayithey RF, Tutu-Danquah C 2024. Interrogating the relationship between multiple intelligence patterns and academic performance among pre-service teachers. *IFE Psychologia: An International Journal*, 32(1): 111-124.
- Beencke A 2024. *The Value of Intellectual Virtues in Critical Thinking Education*. Doctor of Philosophy thesis. Australia: School of Education, The University of Queensland.
- Bihasa DB, Madrigal HB, Ladia EM 2024. A journey of a Filipino pre-service teacher before entering the Department of Education. *Eureka: Journal of Educational Research*, 3(1): 101-114.
- Boonchoo K, Nokkaew A 2025. Enhancing pre-service mathematics teachers' ability to recognize bias, discrimination and inequality in linguistically diverse primary mathematics classrooms through critical discourse analysis and combining content trajectory and language trajectory. *Journal of Practical Studies in Education*, 6(5): 117-130.
- Boy S, Savaşçı M 2024. Pre-service EFL teachers' research attitudes and critical thinking dispositions. *ELT Research Journal*, 13(2): 127-166.
- Budayasa IK, Rahaju EB 2025. Probability problem-solving: the role of probabilistic thinking of undergraduate mathematics education students with feminine female gender and field-independent cognitive style. *Perspektif nauki i obrazovaniya*, 2(74): 228-242.
- Bwembya I, Daka H, Beatrice B 2024. Transformative pedagogies: Cultivating educators for 21st century graduates. *International Journal of Advanced Multidisciplinary Research and Studies*, 4: 289-295. 10.62225/2583049X.2024.4.5.3231
- Carvajal ALP, Fernandez TM, Pangilinan AM, Obod MM, Amihan SR, Sanchez RD, Sanchez JJD 2025. Future-proofing teachers in reframing teacher education curriculum in the Philippines: basis for policy recommendations. *International Journal of Open-access, Interdisciplinary and New Educational Discoveries of ETCOR Educational Research Center*, 4(2): 235-252.
- Cem Ö, Aydın K 2025. Basic skills of 21st century teachers. *Australian Journal of Teacher Education*, 50: 75.
- Compton L 2024. *Investigation Of Knowledge Needed By Teacher Mentors To Support Pre-Service Teachers To Use Information And Communication Technologies During Teaching Practicums*. Doctoral dissertation. Melbourne, Australia: RMIT University.
- Cuhadar C 2018. Investigation of pre-service teachers' levels of readiness to technology integration in education. *Contemporary Educational Technology*, 9(1): 61-75. <https://izlik.org/IA53EC46ZK>
- Darminto D, Handoyo E, Wardani S, Subali B, Widiarti N 2025. Effective teaching strategies to enhance critical thinking skills in education: a literature review. *Edunesia: Jurnal Ilmiah Pendidikan*, 6(2): 948-964.
- Davidson SG, Jaber LZ, Metcalf A 2024. Learning to listen: cultivating pre-service teachers' attunement to student thinking. *Journal of Science Teacher Education*, 35(5): 504-523.
- Fadillah ZI, Hashim R, Aini S 2025. The strategic role of teacher communication in shaping a learning environment that promotes student learning motivation: A qualitative study. *Journal Sains and Education*, 3(2): 37-42.
- Fiel SS, Sermona NLD 2024. Assessing pre-service teachers' level of technical-vocational and pedagogical competencies in Southern Philippines. *International Journal for Multidisciplinary Research (IJFMR)*, 6(6): 1-12.
- Getenet S, Cantle R, Redmond P, Albion P 2024. Students' digital technology attitude, literacy and self-efficacy and their effect on online learning engagement. *International Journal of Educational Technology in Higher Education*, 21(1): 3.
- Haryaka U, Razak NK, Rachman F, Tung KY, Judijanto L 2025. Integrating digital literacy, critical thinking, and collaborative learning: addressing contemporary challenges in 21st century education. *Journal of Human University Natural Sciences*, 52(3): 102-112. <https://doi.org/10.55463/issn.1674-2974.52.3.9>
- Holm P 2025. Impact of digital literacy on academic achievement: Evidence from an online anatomy and physiology course. *E-Learning and Digital Media*, 22(2): 139-155.
- Ibrahim N, Adzra'ai A, Sueb R, Dalim SF 2019. Trainee teachers' readiness towards 21st century teaching practices. *Asian Journal of University Education*, 15(1): 1-12.
- Iraola EA, Romero GR, Millera MJ 2024. Dialogue among educators: Rethinking and recreating scenarios of cooperative and inclusive learning. *International Journal of Educational Research Open*, 6: 100322.

- Jaca CAL, Castañeda Jr WD 2025. Graduate competencies as predictors of the pre-service English teachers' work-readiness. *International Journal of Evaluation and Research in Education*, 14(4): 3211-3223.
- Kamali J, Javahery P 2025. Collaborative reflection as a means to improve teachers' reflective skills: A community of practice perspective. *Reflective Practice*, 26(2): 246-261.
- Kenett YN 2025. The role of knowledge in creative thinking. *Creativity Research Journal*, 37(2): 242-249.
- Khoso FJ, Sahito ZH, Durrani AMA, Chang AS, Sahito KZ 2025. Exploring the influence of 21st century skills on educational practices: How teaching critical thinking, collaboration, and digital literacy is shaping modern classrooms. *ProScholar Insights*, 4(4): 95-111.
- Lamaro G, Kimoga J, Nampijja D, Reichert F 2024. Using case scenarios to foster critical thinking skills among graduate students. *East African Journal of Education Studies*, 7(4): 607-620. <https://doi.org/10.37284/eajes.7.4.2425>
- Li H 2025. Reflective practice for pre-service teachers' professional development. *SAGE Open*, 15(3). 15. 10.1177/21582440251363136.
- Li Y, Kim M, Palkar J 2022. Using emerging technologies to promote creativity in education: A systematic review. *International Journal of Educational Research Open*, 3. 10.1016/j.ijedro.2022.100177
- Li J, Wang Q, Xie N, Qi P 2026. Multi-perspective spatial memory representation in the presence of others. *Cognitive Processing*, 1-11.
- Kiryakova G, Kozhuharova D 2024. The digital competences necessary for the successful pedagogical practice of teachers in the digital age. *Education Sciences*, 14(5): 507.
- Mahmud AF, Mahmud M, Weda S, Munir M 2025. Digital literacy and learning interaction. *FOSTER: Journal of English Language Teaching*, 6(3): 192-210.
- Majeed MK 2025. *Empowering Teachers In The Digital Era Transforming Knowledge Into Practice For Digital World*. Malang, Indonesia: Media Nusa Creative (MNC Publishing).
- Marangio K, Carpendale J, Cooper R, Mansfield J 2024. Supporting the development of science pre-service teachers' creativity and critical thinking in secondary science initial teacher education. *Research in Science Education*, 54(1): 65-81.
- Martinez C 2022. Developing 21st century teaching skills: A case study of teaching and learning through project-based curriculum. *Cogent Education*, 9(1): 1-16.
- Mat NC, Jamaludin KA 2024. Effectiveness of practices and applications of student-centered teaching and learning in primary schools: A systematic literature review. *International Journal of Academic Research in Progressive Education and Development*, 13(3): 1025-1044.
- Morales SS, Baguio JB 2025. Cognitive flexibility and grit as predictors of adaptive thinking teaching practices among public elementary school teachers. *Journal of Scientific Research and Reports*, 31(6): 1149-1161.
- Mugot D, Sumbalan E 2019. The 21st century learning skills and teaching practices of pre-service teachers: implication to the new Philippine teacher education curriculum. *International Journal of Multidisciplinary Research and Publications*, 2(1): 22-28.
- Muh Fitrah, Sofroniou A, Novi Yarmanetti, Ismail IH, Anggraini H, Nissa IC, Widyaningrum B, Khotijah I, Kurniawan PD, Setiawan D 2025. Are teachers ready to adopt deep learning pedagogy? The role of technology and 21st-century competencies amid educational policy reform. *Education Sciences*, 15(10): 1344.
- Nancy JM 2024. Exploring digital literacy and technology integration in pre-service teacher education. *Changing Landscape of Education*, 197.
- Nurzhanova S, Stambekova A, Zhaxylikova K, Tatarinova G, Aitenova E, Zhumabayeva Z 2024. Investigation of future teachers' digital literacy and technology use skills. *International Journal of Education in Mathematics, Science and Technology*, 12(2): 387-405.
- OECD 2025. *Section 5: Teacher Competencies For Navigating Complexities*.
- Olvido MMJ, Dayagbil FT, Alda RC, Uyico BJ, Rodriguez KF R 2024. An exploration of the quality of graduates of Philippine teacher education institutions. *Frontiers in Education*, 9: 1235261.
- Oriel JMP, Estrellan JC 2025. Bridging gaps and realizing gains: lived experiences of teachers in the implementation of Philippine Professional Standards for Teachers (PPST). *International Journal of Science, Architecture, Technology, and Environment*, 2(5): 457-470. <https://doi.org/10.63680/bh6evt66ve3vg7byt>
- Osoño Vanegas HD, Segovia Cifuentes Y de M, Sobrino Morás A 2025. Educational technology in teacher training: A systematic review of competencies, skills, models, and methods. *Education Sciences*, 15(8): 1036.
- Quraishi T, Ulusi H, Muhid A, Hakimi M, Olusi MR 2024. Empowering students through digital literacy: a case study of successful integration in a higher education curriculum. *Journal of Digital Learning and Distance Education*, 2(9): 667-681.
- Rahimova L 2024. Formation of ICT competency of future teachers. *Bulletin of Postgraduate Education*, 30(59): 135-150.
- Ravich K 2024. *Inside Out Creativity: Nurturing Teachers as Creative Catalysts to Transform Education*. Master of Science Project. Buffalo, NY, USA: Department of Creativity and Change Leadership, Buffalo State University, State University of New York.
- Regañon AB 2024. Teachers' level of ICT skills and their perceptions of integrating ICT in teaching. *International Journal of Advanced Multidisciplinary Studies*, 4(4): 235-250.
- Rivera John Paolo R, Lim Valerie L, Sinsay-Villanueva Leih Maruss, Garcia Glenda Darlene V, Tanyag Ivan Harris, Berroya Jenard D 2025. Revitalizing The Philippine Education System: Facilitating Access And Participation To INSET And Teacher Professional Development (TDP). *PIDS Discussion Paper Series, DP 2025-14*, Philippine Institute for Development Studies. DOI: <https://doi.org/10.62986/dp2025.14>
- Roy PK 2024. *Master The Art Of Cooperative Learning: Unlock The Power Of Student Collaboration, Maximize Classroom Potential, And Build Stronger Learning Communities*. Karnataka, India: Amazon KDP.
- Rütti-Joy O 2024. Applying peer rubric feedback in foreign language teacher education: fostering pre-service teachers' oral feedback skills through facilitating reflective moments. In: Paul Voerke, Mergenfel A Vaz Ferreira, Nancy Drescher (Eds.): *Tools, Techniques and Strategies for Reflective Second & Foreign Language Teacher Education*. Springer, pp. 31-52.

- Santagata R, Guarino J 2012. Preparing future teachers to collaborate. *Issues in Teacher Education*, 21(1): 59-69.
- Shen L, Cui W, Wang R 2025. Exploring the longitudinal impact of self-efficacy and self-directed learning on the development of pre-service teachers during educational internships. *Asia-Pacific Education Researcher*, 34(6): 2045-2056.
- Simon E, Nissim Y 2025. Enhancing motivation through teacher-driven project-based learning. *International Journal of Learning, Teaching and Educational Research*, 24(11): 488-508.
- Tam NTT, Tien TN 2024. Unveiling critical thinking pedagogy: Classroom-based assessment strategies in higher education. *rEFLECTIONS*, 31(3): 1178-1195.
- Tican C, Deniz S 2019. Pre-service teachers' opinions about the use of 21st century learner and teacher skills. *European Journal of Educational Research*, 8(1): 181-197.
- Urbani J, Roshandel S, Michaels R, Truesdell E 2017. Developing and modeling 21st-century skills with preservice teachers. *Teacher Education Quarterly*, 44(4): 27-50.
- Utami AB 2025. Cultivating oral proficiency: multiculturalism and pre-service teachers' views on speaking skills. *International Seminar on Humanity, Education, and Language*, 589-598.
- Vallente J, Macalong J, Gaid CC, Paderog SU, Ganat SA, Villarin SJ, Gapol TKS 2025. Bridging competency gaps: A PPST-aligned assessment of pre-service teachers at Initao College. *Journal of Interdisciplinary Perspectives*, 3(11): 169-179.
- Valtonen T, Hoang N, Sointu E, Näykki P, Virtanen A, Pöysä-Tarhonen J, Häkkinen P, Järvelä S, Mäkitalo K, Kukkonen J 2021. How pre-service teachers perceive their 21st-century skills and dispositions: A longitudinal perspective. *Computers in Human Behavior*, 116: 106643.
- Wei H, Yuh AH, Kaewurai W 2024. The case method: an effective approach to enhancing critical thinking. *Journal of Roi Kaensarn Academi*, 9(10): 1826-1840.
- Yang X, Du J 2024. The effect of teacher self-efficacy, online pedagogical and content knowledge, and emotion regulation on teacher digital burnout: A mediation model. *BMC Psychology*, 12(1): 51.

Paper received for publication in December, 2025

Paper accepted for publication in June, 2026