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Integrated digital technology to enhance student teacher's 4Cs through photovoice dialogue: From camera to classroom

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Abstract

Integrating digital technology into classroom has modernized the ways of teaching, providing new chances for the students' efficiency engagement and reflective learning with critical thinking skills. This study aims to investigate student teacher's experience and 4Cs from implementing photovoice dialogue. The study employed a quantitative research design, one-group posttest experimental approach, with 198 student teachers who joined a field trip performing photovoice dialogue activities. Throughout the research, the student teachers applied digital photography to document and shared different educational topics, navigated by classroom discussions which fostered deeper analysis of main concepts. The data were collected; using a 4-point Likert scale assessment measuring the student teachers' learning experiences and satisfaction reflection of photovoice dialogue implementation. The data were then analyzed using SPSS software with descriptive statistics such as mean, standard deviation. The results showed that the student teachers have good experience with photovoice dialogue such personal growth and useful learning activities. They also improve critical thinking, creativities, communication and collaboration skill throughout practicing this approach. It braces teachers in pre-service program to turn into not only greater confident teachers but also introspective practitioners qualified of enhancing critical thinking and community involvement in their future classes.

Keywords: *photovoice dialogue; digital technology; 4Cs; student teachers*

INTRODUCTION

In the current rapidly moving educational sectors, improving student teachers' competence in globalizing 21st-century skills begin a big goal of teacher education. In education, improving the student's 4Cs such critical thinking, creativity, communication, and collaboration plays an important role in 21st-century learning (Battelle for Kids, 2019). These abilities support students' preparedness for complicated socialize, complex civic, and environmental workplace issues and dynamics become such cross-cutting skills in which

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complements of disciplinary knowledge (Kotla et al., 2021; Burke et al., 2025). For student teachers, cooperating these skills into their teaching practice provided trouble experience while faced with classroom management and limited teaching experience (Cho et al., 2025). Meanwhile, the ubiquity of network service devices and digital learning platforms provide useful opportunities to incorporate digital technologies in which authentically enhancing the 4Cs to promote inquiry, prototype, and dialogue. The challenges in class are not entirely to digitize current practices but to value-add the traditional pedagogical strategies that was claimed limiting the students to think critically, productively collaborates, effectively communicates, and showcase the creativities (Lin, 2025; Koehler & Mishra, 2013). Thus, inspiring student teachers to expressively integrate digital technologies into teaching method is important to grow the 4Cs in authentic studying activities. Regarding this, teacher education probably confirm that future educators will be well ready to nurture reflective and innovative learners who could advance in a difficult and global driven technology.

Most literature claimed that the Photovoice has originally proposed by Wang and Burris (1997) as participatory learning tool offering dialogic technique that enhance 21st skills. Generally, photovoice leads participants to i) write and feedback on concerns and strengths through photo, ii) participate in group discussion to inspire critical dialogue, and iii) provides insightful communication to stakeholder's awareness or action (Wang & Burris, 1997). Even though the approach emerged in the health contexts, it has also been adapted globally in classroom to foster student reflection, agency, and engagement (McGladrey et al., 2025; Trout et al., 2019). Even though the Photovoice dialogue could be practice using either digital or non-digital images, however during the project implementations, students used smartphones to provide platform galleries and discus what they have been found to propose solutions (Ciolan & Manasia, 2024). Hence, photovoice contributes as an effective teaching method which interacts comprehensive expression, collaborative talk, and critical thinking and bracing students to be active learners in knowledge development and real life problem-solving.

The rational theory for adjusting implementation digital photovoice dialogue in empowering 4Cs is very notable. Firstly, critical thinking skill is provided to students interrogate things to capture, justify the representative image, analyse meaning, and synthesize context within peer contributions or teams. Current analyses assert that the main steps of photovoice that learners try taking images regarding to inquiry, make group communication, propose identification commonalities, and talk for making decision have constituted using cycle of critical and creative thinking skill (Gabrielsson et al., 2022; Mannion et al., 2021). Secondly, creativity is made through visualize composition, multi-channel storytelling such as image, caption, audio or video, and reevaluating everyday sights into significant evidence for ideas; thus, the functions of photovoice served as a tool reflection-based learning technique in which enhance creative meaning-making by not overloading students cognitively (Andina-Díaz et al., 2023; Balvanz et al., 2024). Thirdly, communication begins foregrounded where student's ability brief captions, narratives reflection, and short presentations for team or relevant audiences. It shares digital displays and exhibitions elongate of the communication in the practical classroom (Trout et al., 2019). Lastly, collaboration ensues in group dialogue as learners discuss interpretations, co-build themes, and arrange gathered action. Therefore, dialogue and action play methodologically importance for photovoice's stakeholders (Lieblein et al., 2018). Implementing digital photovoice dialogue into classroom activities can also changes traditional learning into an engaging, involvement, and feedback that leads students to real life problem solving.

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Digital integration sharpens plan processes. Through the framework of Technological Pedagogical Content Knowledge (TPACK) concept, effectiveness plans leverage the work within pedagogy, technology, and content in which tools mediate actively in learning rather than deliver merely it (Koehler & Mishra, 2013; Lin, 2025). In photovoice pathway, smartphones or tablets user was encouraged to take photo and affordances creation idea; photos discussion pivot strong collaboration; sometimes, students use video conference to support dialogue. Anyways, digital exhibition result such web pages or e-posters also facilitate veritable communication with relevant partners or people. Studies shows that, conducting photovoice in education motivated student engagement, strong learning reflection, and effective dialogue integration of technology show very fulfil outcomes in which consistent to improve the 4Cs in 21st learning century (Hoffmann, 2024; Skoy & Werremeyer, 2020). By clear teaching plan of integrating photovoice dialogue into classroom in educational settings, it is potentially to enhances learners' voice (Brown, 2024). Thus, orienting photovoice dialogue with the framework of TPACK gives a useful tool for digital teaching era, bracing educators to layout meaningful teaching support, enhancing technology studying experiences that enhance students' 4Cs competencies.

Empirical implementation with youth highly emphasizes the value of photovoice's dialogue. Researchers found that the practice from K grade to 12th grade involvement have related to classroom inquiry where it connected to local science and environmental problems, growing students' sense of issues, investigation, and solution orientation (Song et al., 2025). By joining photovoice projects, students have also encouraged to get participates in group discussions, shares idea, and face into community-oriented communication, particularly when including opportunities for dialogue and dissemination to the projects (Malka, 2022). These results proofed that the integration of digital workflows in education, photovoice can show accessible, responsive culturally promote learning result for multimodal idea and peer studying.

However, beside these photovoice's dialogue strengths, there are gaps remain. While many studies reported engagement and reflection in learning, there is fewer research directly study how photovoice gains dimensions of the 4Cs applying validated performance or rubrics assessment. The photovoice design details (such as prompt framing instruction, discussion protocols structure, feedback cycles framework, and product audiences input) varied widely in the projects implementation remains as challenges to specific student 4Cs outcomes (Zaman et al., 2025). Given that that adherence to research equity and informed ethical practices such as consent form, privacy participants, and ethical images involvement people or community spaces needs follow digital policies and frameworks, particularly in K grade to grade12 student contexts (Wang & Burris, 1997; Suprapto et al., 2020). By bridging the identified gaps, it guides the researchers to design and study an integrated digital technology to promote student teacher's 4Cs such as students' critical thinking, creativity, communication, and collaboration through photovoice dialogue.

METHOD

Research design

This research conducted a quantitative research approach focusing a one-group posttest experimental approach (Creswell & Creswell, 2017). The one-group posttest design was used to assess the immediate influence activity of the photovoice dialogue after project implementation. The data were collected focusing on participants' reflections including learning experience, and overall satisfaction (Campbell & Stanley, 2015). This research design did not provide a pretest or control group; it just consisted of practical study in field-

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based settings concept where all student teachers engage in the same intervention provided.

In this research, the study instructed student teachers regarding the photovoice dialogue activities, which consisted capturing photos, joining group discussions, and sharing feedback throughout digital technology template. After finishing the activities, student teachers responded to a post survey questionnaire investigating their perspectives of learning experience, critical thinking, creativity, collaboration, and communication. The data were then analysed to show the extent to which the photovoice dialogue offered to improve their 4Cs skills and overall activities satisfaction.

Research participants

There were 198 student teachers participated in the study. The study invited participants joining a field trip to visit Phnom Tamoa Zoo in Cambodia. The respondents were selected regarding convenience sampling technique, where it was a common technique in educational study when the all accessible population size voluntarily joined in the intervention (Etikan et al., 2016). The participants included student teachers from different subject specializations where it revealed diverse perspectives from the activity of photovoice dialogue.

Research intervention

The study intervention was designed to motivate student teachers in an active learner, inquiry-based learning method which cooperated visual dialogue, feedback, and collaboration to foster their learning in 21st century skills. The study intervention applied photovoice dialogue in which it was participatory and visual strategy where students used photo to investigate, insight reflected, and address topics related to educational concepts (Wang & Burris, 1997). During the field trip activities, student teachers occupied photograph digital tools (i.e. tablets, smartphones, or camera) to shoot images relevant to educational concepts such behavioural animal, environmental management, or studying activity provided in the zoo regarding context.

After photo collection activities, student teachers involved in classroom-based discussions to express and contemplate on their photo. The dialogue activities were introduced by prompts motivating learners to analyse, exemplify, and relate investigation to educational context. The discussion structure deliberated to encourage critical understanding, inspire critical thinking, improve creativity, foster collaborative studying, and develop communication skills where were functional key dimension framework of the 4Cs (Oliver et al., 2024; Thornhill-Miller et al., 2023). Thus, using the photovoice dialogue contributed student teachers with authentic chances to apply theory with practice, enhance them to use teaching method creatively while sharpening their 4Cs abilities throughout meaningful experiential study.

Tools and data collection

The data were collected using a structured questionnaire assessment consisting a four-point Likert scale where 4 was Excellent, 3 was Good, 2 was Fair, and 1 was Needs Improvement. The survey items were developed to identify core dimensions including learning experiences and overall feedback to assess the usefulness of photovoice dialogue activities in fostering students' understanding and engagement to enhance 4Cs. The authors adopted a four-point Likert scale as tool eliminated a midpoint of neutral and required participants to intelligible a clear situation selected (Joshi et al., 2015). To guarantee both reliability and validity questionnaire assessments, the tool was checked to content

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validation by two experts in subject areas to review the indicators for clarity, appropriateness, and study's objectives alignment.

Data analysis

The data was analysed using SPSS software (Version 22) to show descriptive statistics including mean and standard deviation. Descriptive statistics displayed a good summary of participants' reflection and allow authors to insight the trends of experiences and satisfaction feedback levels (Pallant, 2020). The analysis viewed on interpreting the mean rating survey across questionnaire items to appoint the advantageousness of photovoice dialogue activities in promoting studying engagement and experiences. Higher average points showed stronger positive experiences, while standard deviations shared insight variability of refection within student teachers.

RESULTS AND DISCUSSION

Results

Student teacher's experience from photovoice dialogue

Figure 1 reveals experiences of student teacher from the activity *photovoice* dialogue in which regarding to six variables such as interesting, fun, confidence expression, useful, personal growth, and photography skills. Overall, the study shows that most student teachers perceived the activity of *photovoice* as strongly beneficial due to most of indicators were falling among the excellent average (mean ≥ 3.10), even there was one excepted (mean of Fun was 2.91), where was falling as good.

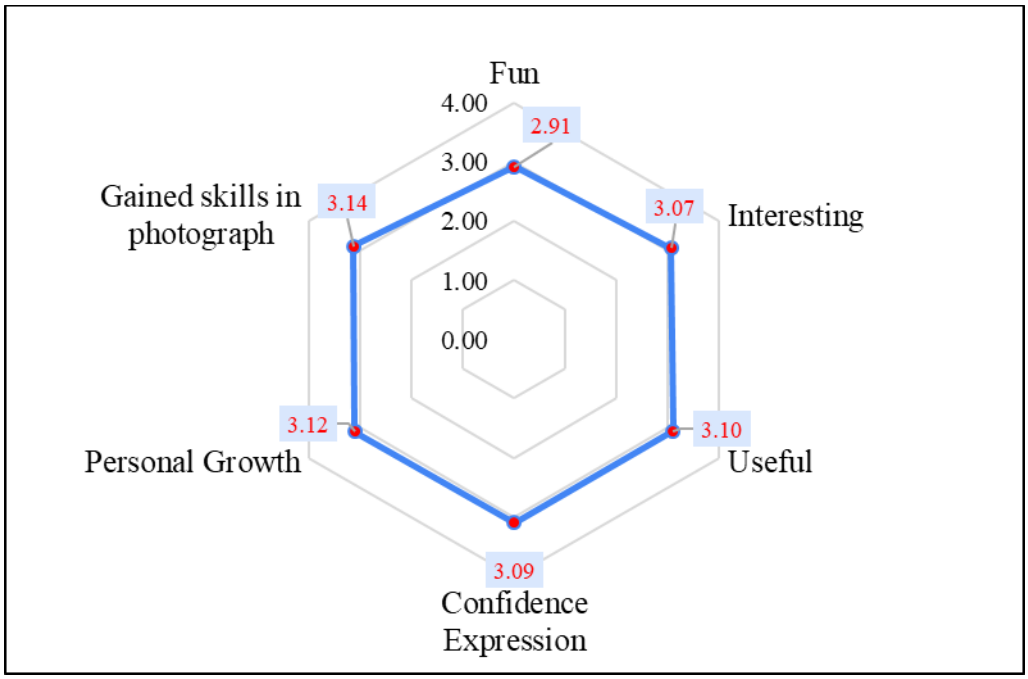

Figure1. Student teacher's experience from photovoice dialogue. Noted: 0.00-1.0: Needs Improvement, 1.1-2.0: Fair, 2.1-3.0: Good, 3.1-4.0: Excellent

Within the six indicators, the highest experience rating was gaining skills in taking photography (mean = 3.14). It was suggesting that student teachers highly valued the creative and technical skills have improved throughout the activity. These findings serve as the evidence that support photovoice as a method's participatory enhancing critical

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observation and visual literacy skills. Similarly, the variables such personal growth (mean = 3.12) and useful (mean = 3.10) provided large ratings, proofing that the project activity not only empowered practical knowledge, but also promoted to the student teachers' personal and professional development.

The indicators of interesting (mean = 3.07) and confidence expression (mean = 3.09) have also presented high score in which reflected that the process of photovoice enabled student teachers to express their perception with assurance while supporting curiosity and engagement. However, the relevant lower mean score in variable fun (mean = 2.91) recommended that while the most of activities were valuable for reflection and development skill, this might have been satisfied as moderately censuring or lacking enjoyable among other variables.

Therefore, the study shows that activities of photovoice dialogue plays as a practical tool in pre-service teacher education, improving not only skills in taking photograph but also supporting to personal growth, confidence and the perceived effectiveness of the studying process. The findings indicate that implementation participatory method in teacher college can enhance student teachers' studying experiences, however, the project should carefully courtesy is recommended to equilibrium enjoyment with academic preciseness.

Critical thinking and creativities skill from photovoice dialogue

Figure 2 shows the perception of student teachers on creativity and critical thinking skills that upgraded through the activity *of* photovoice dialogue. The findings were determined on seven variables as provided in the figure below. The mean score overall was 3.03 which standard deviation was 0.05, this pointed that the activity was commonly perceived as bringing up from the level of good to excellent creativity and critical thinking.

Throughout the variables, the highest score rated from participants was enhanced critical inquiry (mean = 3.13), came relatively by gained skills in storytelling (mean = 3.04), and increased awareness of environmental issues (mean = 3.04). These results contributed that the photovoice dialogue motivated student teachers to involve in deeper inquiring, critically reflected on realities observation, and communicate their ideas effectively regarding narrative storytelling. This result insists photovoice as a tool which evokes analytical dialogue and encourages inquiry-based learning.

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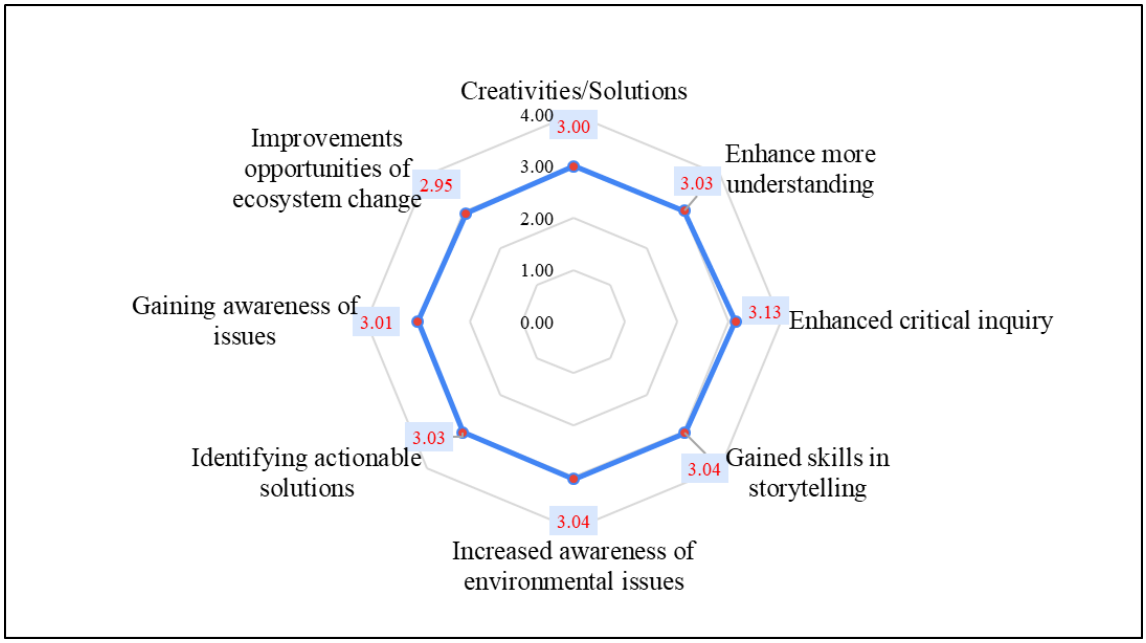

Figure2. Critical thinking and creativities skill from photovoice dialogue (Mean: 3.03, SD 0.05)
Noted: 0.00-1.0: Needs Improvement, 1.1-2.0: Fair, 2.1-3.0: Good, 3.1-4.0: Excellent

Other indicators including enhance more understanding and identifying actionable solutions (mean = 3.03) have also valued positively. This demonstrated that student teachers recognized the feasible of the occurrences to traverse awareness with realistic problem-solving. The variable gaining awareness of issues (mean = 3.01) could fall among the good score. It highlighted that the approach heightened student teachers' sensitivity to educational and community challenges.

Moreover, the item improvements opportunities of ecosystem change (mean = 2.95) indicated Good rating, this shows that it impacted in promoting issues awareness into systemic or ecological change. This could feedback the complexity of issuing institutional or environmental transformations between the insufficient scale of classroom-based activities. In general, the study presented that photovoice dialogue is a productive pedagogical approach for reinforcing pre-service teachers' creativity and critical thinking. It not only enlarged their capacity to analyze and inquiry concerns but also consolidated their communication and storytelling skills which it is the main competencies in teacher training.

Communication and collaboration skill from photovoice dialogue

Figure 3 presents perceptions of student teachers on collaboration and communication skills development throughout the activity of photovoice dialogue provided. The findings have been accessed among seven items, with an overall average value was 3.00 and standard deviation was 0.03. Regarding the assessment scale, the results pointed that student teachers commonly perceived their collaboration and communication skills as the good rating scale.

The highest score item was engaged students to learn (mean = 3.07), this suggested that photovoice sustained a participatory and interactive environment in which enthusiastic student teachers to be active students. The items improved communication skills (mean = 3.04) and enhanced community programs (mean = 3.02) illustrated that these learning activities not only provided interpersonal communication but also motivated

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student teachers to integrate their studying with engagement in community which it is an initial skill for educators in the future.

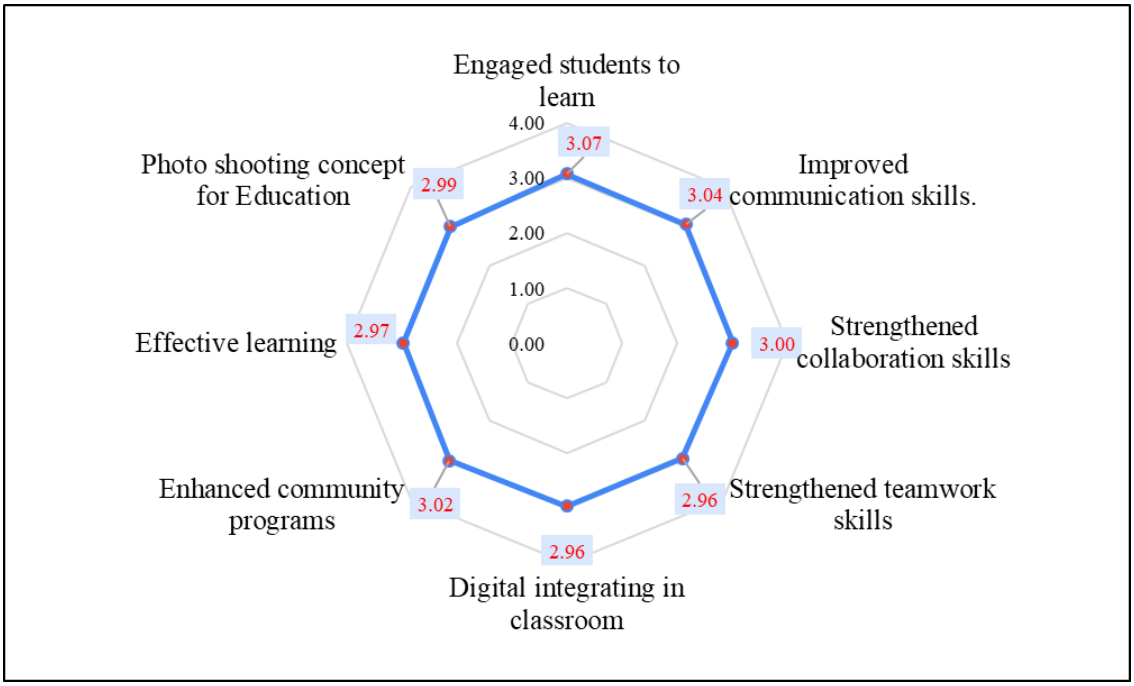

Figure3. Communication and collaboration skill from photovoice dialogue (Mean: 3.00, SD= 0.03)
Noted: 0.00-1.0: Needs Improvement, 1.1-2.0: Fair, 2.1-3.0: Good, 3.1-4.0: Excellent

Other variables such strengthened collaboration skills (mean = 3.00) and strengthened teamwork skills (mean = 2.96) showing good score. This indicated that student teachers have been improved these skills. Moreover, this approach has deepened collective problem-solving and teamwork skills.

In sort, the study shows that photovoice dialogue presents importance pedagogical tool to foster collaboration and communication within preservice teacher education. It improves student teacher engagement, advances communication competencies, and develops community-based learning. Entrenching guided collaborative projects, structured training, and detail connected to classroom activities could nurture the entire effectiveness of *photovoice dialogue* in empowering pre-service student teachers' communicative and collaborative capacities.

Discussion

The results show that photovoice dialogue foster student teachers' studying by improving photography skills, engaging reflection and growing personality. High ratings in personal growth, photography and usefulness indicated that participatory method motivated personal understanding through good practice (Hoffmann, 2024; Trout et al., 2019). Better confidence and interest show that photovoice enhance a good environment for sharing and collaborating (Gabrielsson et al., 2022). The smaller fun responding probably feedbacks the intellectually bruising nature of inquiry reflection (Thornhill-Miller et al., 2023).

Moreover, photovoice dialogue productively improved student teachers' critical thinking and creativity skills. High responding in critical thinking highlight involvement in reflective investigation and analytical reasoning, allowing high suggestion for teaching participatory visual pedagogy for learning through inquiry-based (Zaman et al., 2025; Wang

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& Burris, 1997). Development in communication and storytelling indicated that student teachers may articulate deep understanding, converting investigation into narratives regarding critical thinking and creativity skills (Gabrielsson et al., 2022).

Furthermore, study also insights that photovoice dialogue effectively empower student teachers' communication and collaboration skills. Good engagement scores propose that participatory learning activities motivated active discussion and supporting student involvement (Wang & Burris, 1997; Leung et al., 2024). The results on collaboration and communication also consistence with previous studies which notifying the way of participatory approaches in developing group work and making dialogue (Mannion et al., 2024; Hannes & Parylo, 2014). On the other hand, the various ability for the student teachers in digital integration and teamwork suggested for a guided facilitation to be fostered prior and during the project implementation is required. This study concurs to Darling-Hammond (2017) suggesting that the teacher training program should explicitly integrate more technology-enhanced pedagogy and collaborative practices.

CONCLUSION

This study shows that photovoice dialogue is a useful participatory pedagogical method for teacher education in pre-service program, significantly fostering the 4Cs (creativity, critical thinking, collaboration and communication. Student teachers responded valuable gains in reflective engagement, photography skills, storytelling, personal growth and confidence. This indicates that the method promotes both affective and cognitive development. Overall, the findings demonstrate the range between good to excellent score in which suggests that the implementation of photovoice dialogue was perceived as effective teaching and learning by student teachers to cultivate practical reflection, personal development, and enhancement of communication competency.

In summary, photovoice dialogue displays an encouraging participatory approach which connects experiential studying with development skill for analytical and collaborative competence. Throughout integrating visual imagery, talk, and feedback, it braces teachers in pre-service program to turn into not only greater confident teachers but also introspective practitioners qualified of enhancing critical thinking and community involvement in their future classes. Future study may enlarge on these results by investigating longitudinal influence of photovoice dialogue on teaching practice profession and examining how its incorporation with collaborative pedagogies and digital can greater develop teacher training curriculum.

AUTHOR CONTRIBUTION

The first and second author designed the research instruments, reviewed the relevant literatures, gathered and analyzed the data, and reported the discussion of the study's finding sections. The third author, in the role of technical support, suggested helpful advice within the research such as proof reading and manuscript organization. All authors have reviewed the manuscript for accuracy

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