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Exploring the Relationships between Digital competence, ICT Self-efficacy, Collegial collaboration and Infrastructural support: An Explanatory Sequential Mixed-Methods Study among Culture and Arts Preservice Teachers

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ABSTRACT: The study explored the digital competence among Culture and Arts preservice teachers and the contributions of ICT self-efficacy, collegial collaboration, and infrastructural support using a mixed-methods, explanatory sequential design. In the quantitative phase, 53 preservice teachers completed a validated survey. A questionnaire based on the "Digital competence of educators (DigCompEdu)" was used in this research. Quantitative results showed high overall levels of digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support, with no significant gender differences across variables. Furthermore, significant relationships between digital competence and ICT self-efficacy and between digital competence and collegial collaboration were found, whereas infrastructural support was not significantly correlated with digital competence. In qualitative phase, a semi structured interview was conducted with five participants from the survey sample. Thematic analysis identified self-directed learning, formal education and social support, and academic-driven digital exposure as key explanatory factors. These findings underscore the importance of fostering ICT self-efficacy and collaborative learning environment for teacher preparation programs, particularly within Culture and Arts education programs, offering evidence-based direction for strengthening preservice teachers' digital readiness.

Keywords: Digital competence, ICT self-efficacy, collegial collaboration, infrastructural support, Culture and Arts preservice teachers

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I. Introduction

The rapid advancement of technology in the 21st century has also transformed educational landscapes, in which there has been a growing focus on digital competence as a requirement for all teachers (Alieto et al., 2024; Momdjian et al., 2025). In recent decades, a substantial body of research has shown that integrating information and communication technology (ICT) in education enhances student engagement, facilitates innovative pedagogical approaches, and improves overall learning outcomes (Almerich et al., 2024; Komar et al., 2022; Misut & Pokorny, 2015). Consequently, digital competence is used as a term referred to as the effective use of digital knowledge, skills, and attitudes. It is one of the most important components of ICT integration in classrooms (Pozas et al., 2021). Several studies have also emphasized that the enhanced digital competence of educators and the ability to use information and communication technology (ICT) in instruction as 21st century skills are crucial for facilitating and supporting the learning of students (Israel et al., 2015; Ottenbreit-Leftwich et al., 2018; Tomcyzk & Fedeli, 2022). The increasing reliance on ICT in teaching and learning has led to growing expectations for future educators to develop and be equipped with digital self-efficacy and digital literacy for evolving technological contexts (Rubach, 2021).

Although many teacher education programs have to meet the ever-increasing need for preservice teachers to acquire digital competences (Momdjian et al., 2025), discrepancies in the digital competence levels of teachers remain a pressing issue, as they contribute to widening educational inequalities among schools (Yoon, 2022). According to previous studies (Instefjord & Munthe, 2017; Fang et al., 2024), one of the crucial factors hindering preservice teachers' effective use of technologies is barriers related to internal factors (constructivist beliefs, attitudes toward teaching, ICT equipment, and confidence) and external factors such as resources, training, and infrastructure. Self-efficacy beliefs for technological use have been widely accepted by researchers as a significant determinant of technology competencies (Abbitt, 2011; Birisci & Kul, 2019). According to Dai (2023), the lack of ICT facilities can be very challenging for teachers who long use high-tech equipment for teaching, so having enough technological resources is one of the most important prerequisites for ICT integration in the school setting.

In light of this, owing to global digitalization trends, educational institutions have increasingly emphasized the importance of digital competence in preservice teacher training programs. Various policies and frameworks, such as the European Framework for the Digital Competence of Educators (DigComEdu) and UNESCO's guidelines on ICT education, emphasize the necessity of digital literacy in all educational fields (Vuorikari et al., 2016).

In addition, scholars have investigated the digital competence of in-service teachers (Lucena et al., 2019; Fraile et al., 2018; Krumsvik et al., 2016) and preservice teachers (Cebi and Reisoglu, 2019; Dai, 2023; Elstad & Christophersen, 2017; Hoang, 2024; Krumsvik et al., 2016; Martin et al., 2019). With respect to the studies conducted among preservice teachers, most of these were preservice teachers who specialize in computer education and instructional technologies (Cebi and Reisoglu, 2019), humanities, social sciences, mathematics and natural sciences (Elstad & Christophersen, 2017), English (Dai, 2023; Hoang, 2024), and future elementary grade teachers (Casillas-Martin et al., 2019).

Noticeably, would-be culture and arts education teachers are underserved by research, particularly in the context of ICT self-efficacy, collegial collaboration, and infrastructural support. Most existing studies focus on the technological integration of general education, leaving a gap in understanding what factors significantly affect the digital competence of preservice teachers. Furthermore, digital

competence is not solely dependent on an individual's technical skills but also shaped by external factors such as collegial collaboration and infrastructural support. Studies have shown that teachers who engage in professional learning communities and collaborative environments tend to have higher levels of ICT confidence and competence (Fang et al., 2024; Shah, 2012). Additionally, access to digital resources and institutional support are critical components of digital competence that should be studied. As noted by previous studies, the successful use of digital tools is related to actions taken at the school level, such as the development of ICT plans and ICT support and infrastructure (Badia et al., 2014; Tondeur et al., 2008).

Therefore, this study aims to investigate how culture and art preservice teachers perceive their ICT self-efficacy, the role of collegial collaboration, and the availability of infrastructural support in developing their digital competence to address this knowledge gap and population gap. By investigating these factors, this study seeks to provide insights into specific challenges and opportunities faced by future educators in the field of culture and arts, offering practical recommendations for teacher education programs, helping institutions design more effective training, improving access to digital resources, and fostering collaborative learning environments that enhance digital competence among future culture and arts educators. This proposed study aims to enhance the understanding of digital competence in the context of culture and arts education, benefiting educators and researchers.

Research Questions

This research aims to explore culture and arts preservice teachers' digital competence in terms of their self-efficacy in ICT use and their perceptions of collegial collaboration and infrastructural support. The research is guided by the following questions:

1. What are the respondents' perceived levels of digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support?

2. Is there a significant difference in the respondents' perceived level of digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support when the data are grouped across genders?

3. Is there a significant relationship between respondents' digital competency and ICT self-efficacy, collegial collaboration, and infrastructural support?

4. What are the reasons that contribute to the high level of the respondents' digital competence?

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II. Review of Related Literature

Digital Competence

Digital competence has been widely discussed and has many approaches in the literature. The term ICT competency has been used interchangeably with ICT literacy (Li, 2021), digital competency (Krumsvik, 2014), digital literacy (Borthwick & Hansen, 2017), information literacy, digital skills, technology skills, and IT skills (Potyrala & Tomczyk, 2021). Among these ideas, many studies have been conducted on digital literacy as a crucial component to adapt in the digital age (Yoon, 2022). Basic components for citizens in the digital age should go beyond basic learning of basic digital skills and instead incorporate a variety of perspectives, such as creative thinking, communication, cooperation, and ethics (Roll & Ifenthaler, 2021). Since 2010, digital competence has been defined as not only the ability to use digital tools but also attitudes toward and perspectives on digitalization. For instance, Vuorikari et al. (2016) presented the idea of digital competence for citizens, stressing the importance of information literacy and digital content creation as well as attitudes and viewpoints regarding privacy, copyright compliance, and digital culture.

Digital competence is recognized as a crucial skill for 21st century teachers, which includes knowing how to use information and communication technology (ICT) in the classroom, and it is one of the key skills that teaching staff should possess (Potyrala & Tomczyk, 2021; Sang et al., 2010). Digital competencies are considered part of 21st century skills, and for students to acquire those competencies, it is necessary that future educators develop those digital competencies (Karakoyun & Lindberg, 2022). This idea highlights the importance of developing digital competencies as a critical component of preservice teacher training for future practice (Howard et al., 2021). After the 21st century, digital competence became essential as a basic skill not only in society but also in schools (Yoon, 2022). Among the several theoretical frameworks developed to measure digital competence, the European Digital Competence Framework (DigCompEdu) has been widely used, as it identifies key areas such as information and data literacy, communication and collaboration, digital content creation and problem solving (Punie et al., 2013).

Several studies have assessed the digital competence of preservice teachers and in-service teachers and highlighted several parallels and differences found in various studies. According to Lucena et al. (2019), although both preservice and in-service teachers generally have basic ICT skills, technology integration into practice is still not yet fully established. This is evident in the findings of Casillas-Martin et al. (2019), in which early childhood education preservice teachers in Spain were found to lack sufficient digital competence for academic and professional use despite being considered “digital natives”. This further supported the findings of the study of Nabhan (2021), which indicates that although preservice teachers have basic ICT abilities such as communication and information access, they lack sufficient understanding of important topics such as digital culture and reflective technology use. The results from the study of Alsanib (2023) also revealed that preservice teachers majoring in art in Saudi Arabia have an average level of integrating technology into their future practice. On the other hand, Krumsvik et al. (2016) determined that professional variables, such as experience, formal ICT training, and school affiliation, exert a greater impact on digital competence, especially for in-service teachers. In addition, the study of Cebi and Reisoglu (2019) revealed that structured digital competence training significantly improved preservice teachers’ ICT skills in Turkey, whereas research on teachers in Spain (Lucena et al., 2019) revealed that their digital competence remained low because of insufficient initial training.

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Additionally, the development process of digital competence differs across nations. Preservice teachers from Spain and Saudi Arabia, as noted by Fraile et al. (2018) and Nabhan (2021), learned their ICT competence through autonomous informal learning, whereas teachers from Norway, as studied by Krumsvik et al. (2016), gain expertise more through systematic ICT training and continuous professional development. However, differences in the factors influencing digital competence emerge. Casillas-Martin et al. (2019) suggest that gender plays a role, with male preservice teachers rating their ICT competence higher, whereas Lucena et al. (2019) argue that gender does not significantly affect digital skills. Several studies have shown that male teachers tend to be more competent in the use of ICT than female teachers are (Almerich et al., 2024; Cattaneo et al., 2022). In contrast to the results of this study, the results of prior research have shown that women are more competent than males at using technology to conduct differentiated learning activities to support the learning process (Chaiban & Oweini, 2024).

These findings highlight a consistent difference in the digital competence of preservice teachers across different countries, despite their familiarity with basic ICT skills. While they effectively use technology for personal activities, preservice teachers' ability to integrate digital tools into educational contexts remains underdeveloped, particularly in digital content creation and problem solving. The key influencing factors include teaching experience, institutional support, and ICT training, with mixed findings on the role of gender. Studies suggest that targeted training programs guided by frameworks such as DigComp are essential for enhancing digital proficiency, ensuring that future educators can effectively utilize technology in their teaching practices. Moreover, the inconsistency of results demands continuous investigation of the variable gender. Additionally, cross-country comparisons are needed to address policy differences in teacher education programs and develop strategies that support comprehensive digital literacy development.

ICT self-efficacy

Self-efficacy, as defined by Bandura (1997), is the belief of an individual in their capacity to strategize and achieve a certain goal or behavior. In the education context, self-efficacy can be described as the belief in one's ability to bring out desired outcomes in terms of student engagement and learning (Goldhammer et al., 2016; Paetsch, et al., 2023). Moreover, information and communication technologies (ICTs) have the potential to enhance teaching and learning and influence the development of students' digital competencies (Paetsch et al., 2023). The findings of Wang and Zhao (2021) support the idea that improving preservice teachers' confidence in using ICT can significantly impact the knowledge that teachers need to integrate technology effectively into their teaching. Self-assured individuals are more capable of acquiring digital competence in the use of ICT (Tondeur et al., 2018), as ICT offers numerous ways for students to learn and allows teachers to employ various teaching methods (Peng, 2024).

Bandura's theory (Bandura, 1997) infers that preservice teachers' ICT self-efficacy beliefs, such as effectively integrating ICT into teaching and learning, may have strong positive effects on their ability to attain ICT competencies (Sadaf et al., 2012; Zhang et al., 2023). This theory is consistent with the findings that preservice teachers' subjective norms about technology and their development of self-efficacy were positively impacted by studying authentic learning environments. This finding supports the notion that while practical, hands-on experiences increase their confidence and capacity to employ

these skills (perceived behavioral control), social factors (such as peers and instructors in real-world settings) can positively shape their views on technology use (Valtonen et al., 2015).

Teachers' beliefs are among the most identified internal elements that impact their use of technology. As numerous types of beliefs are associated with technology use (Lawrence & Lentle-Keenan, 2013; Schmitz et al., 2023). Teachers' beliefs on learning (Jacobson et al., 2010), teachers' beliefs on teaching (Kim et al., 2013), beliefs about the advantages of technology (Miranda & Russell, 2011) and teachers' ICT beliefs (Lomos et al., 2023) are included in this. Teachers' self-efficacy is a process of quality interaction in the classroom (Zee et al., 2016). It has been suggested that teachers' self-efficacy might influence student academic outcomes, including achievement and motivation (Caprara et al., 2006). Teachers' educational beliefs can affect how they use technology, as Gil-Flores et al. (2017) discovered that their pedagogical beliefs significantly affect how they use ICT. Moreover, many studies have indicated that teachers' positive attitudes toward technology, their prior experiences with technology, and their technological skills are essential internal factors that positively influence their use of technology in educational settings (Cabellos, et al., 2024; Cifuentes et al., 2011; Dogan, et al., 2021; Lomos et al., 2023; Xu & Zhu, 2023). The findings of Christensen (2023) revealed that men tend to rate their beliefs in using digital skills higher than women do but also emphasized that it is not fixed or universal, as it could be shaped by societal and cultural factors.

It is imperative that educators maintain a positive attitude while employing technology in an innovative and effective manner. However, Kundu et al. (2020) reported that teachers had moderately low ICT self-efficacy across the technological, pedagogical, and integration domains. In contrast to this, results from the study of Birisci & Kul (2019), revealed that preservice teachers in Turkey had high levels of technology integration self-efficacy beliefs, with a high-level positive correlation with techno-pedagogical education competency, where ethics, design, exertion, and proficiency were revealed as predictors of technology integration self-efficacy. Additionally, the results of the study of Lee & Lee (2014) revealed that preservice teachers with more positive attitudes toward computers and greater ability for lesson planning showed greater increases in their level of self-efficacy for technology integration.

Across multiple studies, a common theme emerges that confidence in using ICT is influenced by a supportive environment for using ICT and teaching information literacy. It changes as one gradually gains knowledge, skills, and experience. Therefore, the level of student teachers' self-efficacy should be evaluated, and self-efficacy beliefs for curriculum-related areas, in addition to their information literacy, and their ICT usage should be evaluated, as should their actual knowledge (Al-Senaidi et al., 2009). In the educational field, the development of digital skills in teachers contributes to the improvement of effective student learning, along with high levels of self-efficacy, as reported in several studies. Therefore, continuing research that accounts for the relationship between ICT self-efficacy and digital competence is important.

Contextual factors: Collegial Collaboration and Infrastructural Support

People are meant to live and work together, and interdependent efforts have produced many human accomplishments and causes (Bandura, 2000). In the context of integrating ICT into teaching practices, whether teachers and other stakeholders maintain a well-functioning, coordinated relationship can significantly influence overall instructional outcomes (Dai, 2023).

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According to Blackwell et al. (2014), external factors constitute one of the major categories that influence teachers' usage of technology. These external factors encompass several key dimensions, particularly the opportunity for professional development specifically focused on information and communication technology (ICT) (Marwan & Sweeney, 2010; Xu & Zhu, 2023). The support received from technological specialists (Dogan et al., 2021), access to technology resources (Liu et al., 2017), and financial support from schools (Kormos, 2022) also play crucial roles in or inhibit teachers' technology use (Blackwell et al., 2014). Bandura (1997) also claimed that vicarious experiences and verbal persuasions are two of the major sources that affect individuals' self-efficacy. Building on this idea, it can be understood that contextual factors such as collegial collaboration provide opportunities for vicarious experiences and verbal persuasion and that a lack of infrastructural support influences individuals' mastery experience. This highlights that this study not only examines culture and arts preservice teachers but also explores how these contextual factors shape their perceptions of digital competence.

It was discovered that collegial collaboration provides more chances for peers to learn about ICT. As a result, preservice teachers' competencies under the demands of integrating ICT into instructional activities might be improved (Hatlevik, 2018). Previous studies have shown that the integration of information and technology strategies into instructional sessions is essential for teachers to enrich their professional knowledge (Vanderlinde & Braak, 2010). In other words, as technology has become an essential component of education and for future educators to be effective in modern classrooms, they must be equipped and develop a comprehensive set of technological skills.

Furthermore, a notable body of research highlights that effective technology use in education is positively correlated with teacher collaboration, which also demonstrates that collaborative efforts have a favorable effect on how technology is incorporated into classroom practices (Fang et al., 2024). Numerous findings consistently reveal a positive correlation between teacher collaboration and effective technology use in education (Aldunate & Nussbaum, 2013; Kim et al., 2013; Lomos et al., 2023). This link also holds true for other collaborative types, such as collaboration with external partners (Erickelmann, 2011) and ICT-related collaboration (Krumsvik, 2005). Studies also suggest that teacher collaboration may have a greater impact on ICT use than the mere availability of infrastructure (Gil-Flores et al., 2017). Furthermore, a collaborative school environment significantly predicts teachers' effective ICT integration in classrooms (Dexter et al., 2002).

Moreover, Vanderlinde and Braak (2010) defined ICT infrastructure as the perceived availability and suitability of ICT tools such as hardware, software, and peripheral equipment provided in schools. While Priscilla et al. (2012) defined ICT infrastructure as the availability of equipment, software, internet access, and other similar resources in the school. Gil-Flores et al. (2017) revealed that the availability of educational software, teacher ICT training collaboration among teachers, perceived self-efficacy and teaching concepts influence classroom ICT use. The results from the study of Nordgren et al. (2021) also emphasize that teamwork alone is not enough to ensure effective teaching and that many teachers lack the tools and infrastructure they need for planning and preparation.

Therefore, one of the requirements for ICT integration in the educational setting is the availability of enough technological resources (Cabellos et al., 2024). A lack of ICT resources and support is widely acknowledged as a major hindrance to the process of technology integration in the context of education. Similarly, findings revealed that the use of technology in teaching can foster great innovation in teaching methods (Shamim et al., 2024). It is suggested that when teachers work in an

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innovative climate, they are more inclined to incorporate technology into their teaching practices (Chou et al., 2019; Ninkovic et al., 2023).

These findings imply that teachers who teach in environments characterized by collaboration or innovation are more likely to utilize technology in their instructional methods. Building on this idea, preservice teachers are being prepared to teach professionally to create technology-enhanced learning environments for students. It can be understood that collegial collaboration and infrastructural support may affect the use of technology by preservice teachers in developing and delivering lessons. This underscores the importance of knowing how these external factors affect preservice teachers' digital competence in the field of culture and art education.

III. Methodology

Research Design

This study employed an explanatory sequential mixed-methods design. The design first encompasses the gathering of quantitative data, after which a qualitative phase follows to explain or expand on the findings of the quantitative phase (Creswell & Clark, 2011). The quantitative phase involves gathering numerical data focused on examining the level and exploring the relationships among the preservice teachers' level of digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support through survey questionnaires. On the basis of the quantitative results, a single key variable was selected for deeper investigation through qualitative inquiry. The researcher conducted multiple shots of interviews to determine which factors contributed to the high or low level of the respondents' digital competence. By integrating the strengths of both the quantitative and qualitative approaches, this explanatory sequential design enables a more nuanced and detailed exploration of the research question, ultimately resulting in a more comprehensive understanding of the phenomenon.

Respondents of the Study

The respondents of this study consisted of preservice teachers enrolled in a Bachelor of Culture and Arts Education program at a university with a total population of 114. For the quantitative data, Slovin's formula was used with a margin of error of 10% and a confidence level of 95%, and a 53 sample size was obtained. The respondents were selected via simple random sampling, which involves selecting participants randomly from the population. This technique ensures that every member of the population has an equal chance of being selected, reducing bias and increasing the representativeness of the sample (Ahmed, 2024). For the qualitative data, five (5) or 10% of those who participated in the survey were interviewed. The participants were purposively selected by the researcher to ensure that the necessary requirements for the study were met. The selection criteria included preservice teachers who demonstrated high digital competence in the quantitative survey and their willingness to participate. This approach ensured a range of viewpoints and deep insights into the factors that contribute to the high levels of digital competence among preservice teachers.

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Research Instrument

In the quantitative phase, to achieve the research objective of evaluating culture and art preservice teachers' digital competence in terms of their self-efficacy, collegial collaboration, and infrastructural support, this study employs a survey questionnaire that integrates an adapted research instrument.

The survey questionnaire was adapted from a previous study by Dai, 2023. Modifications were made to align with the context of preservice teachers in culture and arts education. In total, the questionnaire comprises 20 homogeneous items, with 7 items to measure digital competence, 4 items for ICT self-efficacy, 5 items for collegial collaboration, and 4 items for infrastructural support. A five-point Likert scale ranging from "Strongly agree" to "Agree", "Neutral", "Disagree", and "Strongly Disagree" was used in the questionnaire.

Prior to administering the questionnaire, a pilot test was conducted with prospective teachers from other programs of the same college to ensure the effectiveness of the questionnaire. The adapted research instrument exhibited a good reliability score, as evidenced by its Cronbach's alpha score of 0.717 for digital competence, 0.768 for ICT self-efficacy, 0.812 for collegial collaboration, and 0.757 for infrastructure support. This result confirms the "acceptable" internal consistency, increasing its credibility and reliability for the broader group of prospective teachers of culture and arts education.

Semi-structured interviews

In the qualitative phase, the researcher employed one open-ended question designed to allow participants to freely express their opinions and insights. The primary question was developed by the researcher and validated by a research expert, thereby establishing its content validity and reliability. The researcher used probing, and additional follow-up questions were asked to further elaborate and explore emerging themes.

Ethical Consideration

The study adhered to the ethical standards set by the Data Privacy Act of 2012. The researcher secured the participants' consent before the data were collected to ensure that they understood the research purpose, risks, and benefits. The participants were given the opportunity to continue or withdraw from the study. The anonymity and confidentiality of the respondents were strictly maintained. The obtained data, recordings, documents and interpretations from the survey and interview were stored securely and kept confidential to prevent leakage and unauthorized access to the data, as this was used solely for the purpose of this study.

Data collection procedure

The data were collected over a period of two days. On the first day, the researcher administered a survey questionnaire to the target participants. The respondents were briefed on the study's purpose, were provided with a clear set of instructions, and were assured of the anonymity and confidentiality of their responses. The following day, the researcher retrieved the completed questionnaires. This

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approach allowed sufficient time for the participants to complete the survey while ensuring prompt collection to maintain the reliability and integrity of the data.

For the qualitative phase, the present study utilized semi-structured types of interview questions that were validated by a research expert to ensure that the interview questions were in line with the research questions and were liberated from any form of bias against the participants. Semi-structured one-on-one interviews lasting 15-30 minutes were used to gather the data. Before proceeding to the interview, informed consent was obtained from the participants, and the researcher ensured that the purpose of the study was clearly explained. The participants were assured that there were no risks associated with taking part in the study and were informed of the potential benefits. Participation was entirely voluntary, and participants were reminded that they could withdraw from the study at any time without any consequences. During the session, the researcher posed one main research question and asked follow-up questions on the basis of the participants' responses. To guarantee the accuracy of the data gathered, the interviews were audio recorded with the participants' consent. At the end of the interview, the audio recordings were collected from the interviews, were kept strictly confidential and were not shared with nonaffiliates in the present study to protect participants' privacy and anonymity.

Quantitative Data Analysis Procedure

To test the normality of the distribution of the data, the Shapiro–Wilk test was used. Since the *p* values generated for this study are greater than the alpha level, which is 0.05 and therefore nonsignificant, the data are normally distributed.

In this study, different statistical methods were used to analyze the results. Descriptive statistics, such as the mean and standard deviation, were employed to assess the level of perceptions and attitudes in terms of respondents' digital competency, ICT self-efficacy, collegial collaboration, and infrastructural support. An independent sample t-test was also utilized in this study because it aims to determine the significant differences in the variables of interest. Moreover, the Pearson product moment coefficient was utilized to determine the relationships among the respondent's digital competency, ICT self-efficacy, collegial collaboration, and infrastructural support. Data analysis was performed via the Statistical Package for Social Sciences (SPSS) version 20. To facilitate the analysis of the quantitative data, a coding procedure was also employed. This involved assigning corresponding numbers to the responses collected from the survey questionnaire. The categorical variables in this study were coded using numerical values. For gender, male is coded 1, and female is coded 2. The scale ranges from 1.0-5.0 divided into five equal intervals: 1.0 -1.79 = Very low; 1.80-2.59 = Low; 2.60 – 3.39 = Moderately High; 3.40 - 4.10: High; 4.20-5.00 = Very High.

Qualitative Data Analysis Procedure

For the qualitative phase, the responses were transcribed and translated in Standard English translation, as some of the respondents used their first language, in which they felt comfortable expressing their perspectives and opinions. To ensure that the transcriptions and translations were accurate, the researcher checked and validated them with the participants. The researcher used thematic analysis to analyze and identify themes on the basis of the responses of the participants. Thematic analysis was employed to synthesize the study's findings, involving the identification of codes

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and the development of themes (He et al., 2025). With this approach, recurrent patterns in the data can be systematically represented in relation to the initial research question (Breton et al., 2025). The responses were coded and grouped with their identified themes. These themes were combined, split, and reviewed to ensure that the depth of the data was accurately captured. The respondents of this study were also coded as participants 1, 2, 3, 4, and 5 on the basis of the order in which they were interviewed.

IV. Results and Discussion

The researcher used descriptive statistics, particularly the frequency, percentage, mean, and standard deviation, to analyze and measure the overall level of the respondents' digital competence. The study also discusses the themes that emerged after the data were analyzed. The themes are set as a guide to answer the research question formulated: What are the reasons that contribute to the high level of the respondent's digital competence?

Quantitative findings

Table 1. Levels of the respondents' Digital Competence, ICT Self-efficacy, Collegial Collaboration, and Infrastructure Support

Variables	M	SD	Interpretation
Digital Competence	3.95	0.439	High
ICT Self Efficacy	3.58	0.640	High
Collegial Collaboration	3.83	0.570	High
Infrastructural Support	3.66	0.677	High

Scale: 1.0 -1.79 = Very low; 1.80-2.59 = Low; 2.60 – 3.39 = Moderately High; 3.40-4.10 = High; 4.20-5.00 = Very High

In Table 1, descriptive statistics, specifically the mean and standard deviation, were used to analyze the data. These findings reveal that culture and art preservice teachers have a high level of perceived digital competence, supported by strong ICT self-efficacy, active collegial collaboration, and favorable infrastructural support. Most of the respondents agreed or strongly agreed with statements related to their digital teaching readiness. This aligns with the findings of previous research. For example, Dai (2023) reported that preservice teachers in China also demonstrated high levels of digital competence. Like Dai's participants, the respondents in the current study likely benefited from continuous exposure to digital platforms during their training.

This result also challenges the findings of Casillas-Martin et al. (2019), who argued that while today's youth are typically characterized as "digital natives," they frequently lack the deeper digital skills required in academic and professional settings. Unlike earlier research, which revealed insufficient competency despite frequent technology use, the participants in this study showed both confidence and readiness in using digital resources in learning contexts. This can be understood through the lens of Bandura's social cognitive theory, specifically the concept of self-efficacy. The high level of ICT self-efficacy observed from the would-be teachers demonstrates their confidence in their

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use of digital technologies, which may be attributed to previous positive experiences, training exposure, or familiarity with technology in their learning contexts.

Additionally, the high level of collaboration among peers supports the notion of Bandura (1997) of social learning, where individuals enhance their competencies by observing and interacting with peers. This environment promotes mutual learning and strengthens digital practices. This finding also supports the results from the study of Fang et al. (2024), who highlighted how collaborative efforts have a favorable effect on how technology is incorporated into classroom practices. In line with Bandura's (1997) emphasis on the importance of the environment in molding behavior and capability, the availability of infrastructural support creates an enabling setting that may encourage preservice teachers to explore and enhance their digital abilities.

Furthermore, it is imperative to acknowledge that the findings revealed that would-be culture and arts educators reveal a high level of digital competence. This challenges earlier claims that digital natives lack sufficient digital skills, implying that present educational procedures and environments may effectively nurture digital readiness.

Table 2. Differences in digital competence, ICT self-efficacy, collegial collaboration, and infrastructure support between male and female respondents.

Variables		Mean	SD	t-value	p value	Interpretation
Dependent	Independent					
Digital Competence	Male	3.99	0.541	0.530	0.598	Not significant
	Female	3.92	0.371			
ICT Self-efficacy	Male	3.70	0.686	1.061	0.294	Not significant
	Female	3.50	0.610			
Collegial Collaboration	Male	3. 98	0.569	1.466	0.149	Not significant
	Female	3.74	0.561			
Infrastructural support	Male	3.66	0.619	-.061	0.952	Not significant
	Female	3.67	0.719			

Table 2 shows the level of digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support of the culture and art education preservice teachers, which are treated for significant differences when grouped by gender. The t-test results reveal that the probability values at 0.598, 0.294, 0.149, and 0.952 are all greater than the alpha value of 0.05. This means that there is no significant difference between male and female respondents across digital competence, ICT self-efficacy, collegial collaboration, and infrastructural support. These findings contradict those of prior studies (Almerich et al., 2024; Cattaneo et al., 2022; Casillas-Martin et al., 2019; Chaiban & Oweini, 2024) that determined that gender significantly affects digital skills and suggest that males tend to be more competent in the use of ICT than females are.

However, these findings support the findings of Lucena et al. (2019), who argued that gender does not significantly affect digital kills. The findings of the current study suggest that both men and women have identical levels of proficiency in terms of their use of digital technologies for effective communication and teamwork. Additionally, the results of this study support those of a prior study

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(Zhong, 2011), as it revealed that gender does not significantly influence infrastructural support. These findings imply that preservice teachers who are male and female have comparable degrees of digital competence, ICT self-efficacy, collegial collaboration, and perceived infrastructural support. This suggests that gender does not serve as a determining factor in these areas, and future studies might examine other elements that support preservice teachers' acquisition of digital competency and related abilities.

Table 3. Correlation: ICT self-efficacy, collegial collaboration, infrastructural support, and digital competence

Variables		p value	r-value	Interpretation
Digital Competence	ICT self-efficacy	0.001**	0.453	Significant
	Collegial Collaboration	0.000**	0.714	Significant
	Infrastructural support	0.568	0.-080	Not Significant

**Correlation is significant at the 0.01 level (2-tailed).

Table 3 presents the Pearson correlation coefficient (r) to quantify the relationships and associations between variables, expressing the strength of their relationship (DeGhett, 2014). The table above shows the analysis of the relationships between respondents' perceived level of digital competence and ICT self-efficacy, collegial collaboration, and infrastructural support. The results revealed that ICT self-efficacy has a significant correlation with digital competence (p value = 0.001 < α = 0.05) and a correlation coefficient value of 0.453, indicating that there is a moderate relationship between the two variables. This means that an increase or decrease in the respondents' ICT self-efficacy significantly relates, in a direct relationship, to the level of digital competence of the preservice teachers. Therefore, respondents' digital competence may be influenced by their level of ICT self-efficacy. This finding supports previous research, which revealed that teacher educator efficacy is positively correlated with digital competence (Instefjord & Munthe, 2017).

The findings also revealed that collegial collaboration has a significant correlation with digital competence (p value = 0.000 < α = 0.05), with a correlation coefficient of 0.714, indicating that there is a strong positive relationship between the two variables and that this relationship is statistically significant. This infers that preservice teachers who are more engaged in collaborative activities with peers reported higher levels of confidence and competence in using digital tools for teaching. This aligns with prior research, which emphasizes how collaborative learning helps teachers improve their digital skills (Fang et al., 2024). Peer support likely serves as a form of vicarious experience, one of the four sources of self-efficacy in Badura's framework. In essence, the more they collaborate with peers, the more they help them exchange strategies, which could better enhance their digital competencies. As noted by Shah (2012), collaboration is regarded as a means of expanding teachers' knowledge and a crucial component of their professional growth.

While ICT self-efficacy and collegial collaboration were significantly related to digital competence, infrastructural support showed a lack of correlation to digital competence. This means that an increase or decrease in digital competence is not significantly related to an increase or decrease in infrastructural support. Therefore, preservice teachers receiving infrastructural support do not influence their digital competence. This finding contradicts the study of Cabellos et al. (2024), which

highlighted that successful use and sufficient digital integration in the classroom require sufficient support of technological resources and training from the institution.

However, this finding supports the findings of Dai (2023), who also revealed that preservice teachers' perceptions of infrastructural support are important but are not sufficient on their own to enhance digital competence. One conclusion that could be drawn from this is that although the respondents presumably appreciate the value of infrastructural support, they have not yet had the opportunity to put their opinions into practice in actual teaching settings, which could be misleading to some extent. Another factor could be that some of the preservice teachers learned to gain their digital competence through learning on their own, which could also be noted from the results of the study of Fraile et al. (2018), who reported that preservice teachers learned their ICT competence through autonomous informal learning. Consequently, when preservice teachers are given opportunities to apply their knowledge to actual practice, they will feel more accomplished (Dai, 2023).

Overall, the findings affirm that personal factors (ICT self-efficacy) and social support (collegial collaboration) are more prominent in developing digital competence than simply having access to technology (infrastructure). These findings are consistent with previous research and underscore the importance of Badura's social cognitive theory in understanding how teachers develop digital readiness in education. The results of this study contribute to the growing body of literature emphasizing the importance of personal and contextual factors in shaping digital competence.

Qualitative findings

In this phase, qualitative interviews were conducted to further analyze and explore the reasons why the respondents demonstrated a high level of digital competence. Thus, a semi-structured interview was administered among samples from the same population, and after the necessary information was gathered, the data were analyzed thematically. The thematic analysis of these interviews revealed three key themes that explain the underlying reasons:

Theme 1: Self-directed Learning and Motivation

Three out of the 5 or 60% of the participants had a strong internal drive to learn and integrate emerging technologies. The respondents exhibited intrinsic motivation and strong self-efficacy in mastering digital tools.

The following excerpts are extracted from the interviews:

> "*I need to be updated with the different kinds of technologies from application to equipment in teaching… because it is one thing that makes a teacher."* (P1)
>
> "*We are surrounded by tech-savvy people, through them I also get curious how to use the different digital tools"* (P2)
>
> *"I am someone who never lets things become novel as it is. I would constantly research how it works, watch tutorials, and ask someone who is an expert…staying consistent in accessing digital*

tools has helped me develop my digital competence… the more I indulge myself with it, the more I gained knowledge" (P3).

The participants expressed eagerness to remain updated with technological advances and their desire for learning opportunities. As participant 1 noted, *"I need to be updated with the different kinds of technologies from application to equipment in teaching… because it is one thing that makes a teacher"*, which highlights the strong understanding of the important role that technology plays in education as well as a dedication to becoming proficient with it. It shows how they are induced by the need to stay current with tech in teaching. This finding supports Lopes et al. (2016) in terms of how curiosity becomes part of intrinsic motivation and is key in encouraging active learning and spontaneous exploration. This finding is also consistent with the findings of Tondeur et al. (2018), who noted that individuals who have a strong level of self-efficacy are more capable of acquiring digital competence in the use of ICT, as ICT provides a multitude of ways for students to learn.

The participants also described how their curiosity and eagerness led them to independently explore digital tools beyond formal instruction. As participant 2 said, *"We are surrounded by tech-savvy people; through them, I also become curious how to use the different digital tools".* This shows how their curiosity sparked their interest in trying to learn new digital platforms. They actively seek tutorials, experiment with software, and consistently practice. For example, participant 3 shared, *"I am someone who never lets things become novel as it is, I would constantly research how it works, watch tutorials, and ask someone who is an expert…staying consistent in accessing digital tools has helped me develop my digital competence… the more I indulge myself with it, the more I gained knowledge"*. This shows a proactive strategy in which self-efficacy and ongoing improvement are sparked by the urge to learn. This theme supports the idea that self-regulated learning is vital in building digital skills. These findings align with the studies of Fraile et al. (2018) and Nabhan (2021), who revealed how autonomous informal learning positively influences digital competence. This theme indicates that the participants demonstrated strong internal motivation to improve their digital skills. They actively look for resources and experiences to stay current with technological innovations because of their desire to become effective future-ready educators.

Theme 2: Formal Education and Social Support

Another theme that emerges from the interviews is that early exposure to technology through prior schooling, such as ICT subjects, and support from mentors and peers laid a solid foundation for their digital skills. Two out of 5 or 40% of the participants also supported this theme.

The following excerpts are extracted from the interviews:

"I am an ICT major during my senior high school days…we are trained not just to use software but also digital devices and tools" (P3)

"I had a mentor who was very good at manipulating different digital tools and gave me advices" (P5)

These narratives demonstrate how formal instruction contributes to skill development. This finding supports the findings of Krumsvik et al. (2016), who determined that experience, formal ICT training, and receiving educational support exerts a greater impact on developing digital competence. The importance of mentorship and peer influence also emerged as critical factors in building confidence and skills. This was further supported by participant 5, who stated, *"I had a mentor who was*

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very good at manipulating different digital tools and gave me advice", demonstrating how social interaction-based learning enhances self-confidence and practical knowledge. This aligns with Bandura's theory (1997) of how vicarious experiences and verbal persuasions influence one's mastery experience. The collaborative environment among peers significantly reinforced competency by providing them with opportunities to observe and learn new technological applications.

Theme 3: Academic-driven digital exposure

Three out of 5 or 60% of the participants supported the final theme of how the participants used digital tools not only functionally but also creatively and collaboratively through constant exposure to technology in formal academic contexts.

The following excerpts are extracted from the interviews:

> *"Ever since I was in high school, I am already exposed to technology to help me in doing my assignments and projects."* (P4)
>
> *"I use digital technologies in delivering my instruction or lectures in my teaching."* (P2)
>
> *"Every time my professor will tell me to do a technology-related task, I always take risk to make it, even if my output was not that good, but I am into the learning experience in terms of learning technology."* (P1)

The consistent exposure to digital tools because of academic demands has also pushed them to explore more and learn the use of digital tools. This is further supported by the statement of participant 4 *"Ever since I was high school, I am already exposed to technology to help me in doing my assignments and projects."* All the participants also highlighted that they use digital technologies in their practice teaching, which was supported by the statement of participant 2 *"I use digital technologies in delivering my instruction or lecture in my teaching."* They see the academic tasks as a reason why they have developed their digital competence. They see academic tasks as a learning opportunity to further enhance their skills. As participant 1 said, *"Every time my professor will tell me to do a technology-related task, I always take risk to make it, even if my output was not that good, but I am into the learning experience in terms of learning technology";* this is consistent with the findings of Tondeur et al. (2012), who discovered that preservice teachers progressively gain competence and confidence in using digital technologies for pedagogical purposes when they are required to complete academic tasks that integrate technology. Similarly, Instefjord and Munthe (2017) concluded that learning digital tools not only comes from using digital tools but also from reflecting on how they enhance learning.

They gained literacy through real-world practice, and the repeated practice strengthened their familiarity, which also enhanced their skills and attitudes with respect to the use of technology to perform tasks, solve problems, communicate, and create and share content effectively, critically, and creatively. They did not view technology as a passive requirement but rather as a means to enhance their work. This highlights how course-based requirements and academic demands provide consistent exposure to digital tools, enabling participants to gain both instructional and functional proficiency in a structured learning environment. This reveals how digital competence was also cultivated through repeated exposure to technology in formal academic contexts.

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V. CONCLUSION

This study investigated the digital competence of culture and art preservice teachers via a mixed methods explanatory sequential approach. The results from the quantitative phase revealed that the respondents possessed a high level of digital competence. This suggests their readiness to integrate technology effectively into their future teaching practices. To further understand the underlying reasons contributing to this competence, the qualitative phase investigated the respondents to gain a deeper understanding of the fundamental elements influencing this competency. It was revealed that a variety of interrelated factors influence their level of digital competency. It is shaped by a combination of personal, educational, and contextual factors. The respondents showed self-motivation and initiative in exploring and learning digital tools on their own, exhibiting autonomous learning or self-directed learning tendencies. Equally important was the role of the received formal education and social support. The respondents attributed their competence to structured academic tasks such as technology-integrated assignments and ICT-related subjects, as well as to the guidance of mentors and collaborative learning with classmates.

This study also explored the relationships among digital competency, ICT self-efficacy, collegial collaboration, and infrastructural support among culture and art preservice teachers. Among the factors investigated, the study highlights that collegial collaboration was the strongest predictor of digital competence. This suggests that collegial collaboration could be a key factor in enhancing digital competence. While collegial collaboration and ICT self-efficacy were found to have a significant relationship with enhancing digital competence, infrastructural support showed no significant correlation. Moreover, the results revealed that gender does not play a determining role in how preservice teachers engage in collaboration, perceive infrastructural support, develop ICT self-efficacy, or achieve digital competence. These findings imply that institutional support, training opportunities, and individual motivation are likely more important determinants of these variables than gender-specific traits are.

Overall, these findings suggest that digital competence is not merely a product of access to technology but also the result of learner independence, mentorship, collaboration, and received formal educational support from institutions. Furthermore, these findings have significant practical implications for preservice preparations. This observation highlights the urgency with which challenges impede the development of preservice teachers' digital competence. Although this study has provided insights into this topic, it also has its limitations, as the sample population in this research investigated only preservice teachers of culture and art education. Future studies should use a larger sample size and qualitative methods to provide more personalized insight into preservice teachers' digital competence in terms of their self-efficacy in ICT use and their perceptions of collegial collaboration and infrastructural support.

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