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Enhancing Visual Art Education: Case Study on Exploring the Integration of Digital Tools to Foster Creativity and Innovation of Future Art Educators

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Abstract

Utilizing both qualitative and quantitative methodology, from the grounded theory, this research examined how digital tools can help enhance the creativity of students as future teachers, particularly students of art education and Teaching of fine arts (combined). Research questions focused on determining the prior experiences and perceptions of teachers and students regarding integrating digital tools in art education, specific digital tools used and perceived by students as effective for creativity, digital tools to build future visual arts teachers' creativity and innovation skills as educators, challenges and limitations associated with integrating digital tools in art education. Data were collected through surveys, interviews, and lesson observations. The results from class observations, surveys, and interviews with faculty members revealed that using digital tools for collaboration, and instant feedback alongside creating digital artwork improves certain types of creativity, such as collaborative, innovative, and digital creativity.

Keywords: digital tools, digital creativity, art education, interactivity, collaboration.

1. Introduction

This report is the result of the project "Exploring the Integration of Digital Tools to Foster Creativity", which explored the use of digital technologies in visual arts education. The report presents the results of qualitative and quantitative studies about using digital technologies in the context of the Department of Creative Arts and Art Education at Constantine the Philosopher University in Nitra. Phase I examines students' prior experiences and perceptions of digital technologies and determines missing points that were out of focus in the learning process. Consequently, Phase II explores how these overlooked digital tools can help foster the creativity of students as art teachers. Although artistic endeavors dominantly depend on individual works,

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the collaboration and engagement of students within the instructional framework also have significant importance in art education. The case study provides a comprehensive viewpoint regarding the potentialities and efficacy of diverse digital instruments appropriate for application within the domain of arts education.

The rapid development of digital technologies is transforming ways of communication (Rensburg et al., 2021), tools of creativity (Wang, Li, 2022), and strategies for education (Fernandez, 2019). Numerous studies have tried to explore the significance of digital technologies in art education and creativity. However, a link between pedagogy, creativity, and digital mediums continues to be under-researched.

1.1. Background and Rationale

The advent of digital technologies has revolutionized various sectors, including education. By providing access to a diverse range of digital resources and software, educators can empower learners to experiment, innovate, and express themselves in new and exciting ways (Haleem et al., 2021). This shift is particularly relevant in the context of the Faculty of Education at Constantine the Philosopher University in Nitra, where there is a growing recognition of the need to integrate technology into art curricula to foster creativity. The Department of Creative Arts and Art Education conducted projects regarding creativity in the digital age. One of the projects is "Individual Artistic Expression as Interaction with a Computer" (Project No. 033UKF-4/2012) explores the individual artistic expression of pupils of the 5th and 6th grade of primary schools, which is created by interaction with a computer. It proposes a methodology of art education for creating a digital-electronic image. Another project called "Art Education in Electronic Environment" (Výtvarná výchova v elektronickom prostredí, Project KEGA 2006 3/4021/06) focuses on fostering the creativity of art educators in the digital age.

Despite the obvious benefits of integrating digital tools into art education, there is still a gap in empirical research examining their impact on artist and art teacher creativity in the educational environment. This process requires a thorough analysis of approaches to the use of digital tools and curricula.

This study addresses these gaps by examining the integration of digital tools in the Department of Creative Arts and Arts Education and makes a valuable contribution to best practice in art education in the digital age. The results of this study provide information on aspects to consider when developing curricula using digital technologies. Furthermore, they can serve as a model for institutions seeking to enhance the pedagogical training and professional skills of arts educators in the area of digital technologies. To conclude, since today's social life is directly related to technologies, art education must also develop through their effective use.

1.2. Research objectives

The primary objective of this case study is to explore the potential of digital tools in fostering creativity. This study aims to improve fine arts education practice by examining the current state of integrating digital tools into programs, identifying challenges and opportunities in their implementation, and suggesting effective tools for conducting effective lessons for future art teachers.

Particularly, the study will address the following research questions:

1) What are the prior experiences and perceptions of teachers and students in the department regarding integrating digital tools in art education?

2) What specific digital tools are used and perceived by students as effective for creativity in visual arts education?

3) What digital tools should be incorporated into the educational process to develop future visual arts teachers' creativity and innovation skills as educators?

4) What are the potential challenges and limitations associated with integrating digital tools into art education?

By exploring these questions, the study aims to provide important insights into how to effectively incorporate digital resources into art education, ultimately developing new and engaging learning experiences for students.

2. Literature review

2.1. Importance of Integrating Art Education within the Educational Framework

The current technological era has fundamentally transformed our social lives, including our education through an industry of information (Wang, Lee, 2024; Zhang et al., 2024; Maor et al.,

2024; Xia et al., 2024). Modern technologies in the form of computers (Wang, Lee, 2024), digital applications (Xia et al., 2024), cloud computing, and virtual reality (Zhang et al., 2024) have entered every level of society and affect people's work, and education. The fourth Industrial Revolution has led to an emergency of completely new labor conditions, social welfare sectors, creation in terms of art and media (Szostak, Sułkowski, 2024), our way of communication (Rensburg et al., 2021) due to digital technologies.

However, people without competencies in digital tools could encounter redundancy (Rensburg et al., 2021) and find difficulties in their social lives (Gabriel et al., 2022). Since advanced technologies are evolving eventually including Artificial intelligence, and are starting to dominate (Gabriel et al., 2022), the future will become uncertain and force people to apply their experience in unknown situations (Maor et al., 2024). Therefore, many countries are focusing on improving the digital skills, digital innovation, and creativity of the future workforce (Gabriel et al., 2022; Wang, Lee, 2024).

2.2. Benefits of digitalization and digital literacy in education.

The education system is certainly not exempt from these processes. Various policy documents have already highlighted the digital competency of teachers and students (Spante, 2019). While teachers' professionality is crucial for students (Damanik, Widodo, 2024), students should be up to date with modern technologies (Xia et al., 2024), because the system should prepare young people for a competitive workplace equipped with complex digital technologies (Fernandez, 2019; Wang, Lee, 2024; Damanik, Widodo, 2024). Therefore, several policy documents insist that digital literacy is one of the important skills of the 21st century and should be integrated into the modern educational curriculum as it fosters creativity and collaboration (Tong, 2024; Wang, Lee, 2024; Maor et al., 2024).

Different scientists define digital literacy differently. For example, Gabriel (2022) insists that in Slovenia digital literacy relates to society, in Portugal, it refers to usage and communication, and in Finland and Estonia it is more cross-curricular. The definition of digital literacy has been expanded through the years due to the development of technology. It consisted of acquiring, understanding, and using in 1997, defined as using digital tools confidentially, critically, and innovatively in 2011 (Wang, Lee, 2024), and communication, content creation, and security awareness were added in 2008 by the Digital Competence Framework for Citizens (Ferrari, 2013). While Wang & Lee (2024) provides four kinds of digital literacy, such as photovisual, reproduction, information, and branching, Damanik & Widodo (2024) say the process of being digitally literate occurs when the user acquires an applies (1st stage), gains (2nd stage), and creates (3rd stage). Considering the definitions above, we define digital literacy as acquiring, utilizing, and creating digital products in a confident, innovative, and safe way in our daily lives.

Since digital literacy positively impacts people, including teachers (Damanik, Widodo, 2024) and students, the digitalization of education is also beneficial. The digitalization process in education reflects the transformation of written knowledge into digital knowledge and the advent of a novel approach to disseminating and utilizing educational information (Zhang et al., 2024).

"The process of digitalization in education reflects the transformation of written knowledge into digital knowledge and the advent of a novel approach to the dissemination and utilization of educational information." (Zhang et al., 2024: 2).

Digital tools combined with the Internet have revolutionized the classroom atmosphere by providing interactive and engaging learning experiences. These technologies allow students to access diverse materials for research and reporting, fostering independent learning (Nichols, 2024). Furthermore, the integration of Artificial Intelligence (AI) presents significant opportunities for improving teaching and assessment processes and the management of educational organizations (Niclòs et al., 2024). Digital tools play a vital role in education (Tusiime et al., 2020; Gabriel et al., 2022) by enhancing teaching methodologies (Gabriel et al., 2022; Graessler, Taplick, 2023; Wang, Lee, 2024; Zhang et al., 2024), facilitating student engagement with interactivity (Graessler, Taplick, 2023; Wang, Lee, 2024; Xia et al., 2024; Szostak, Sułkowski, 2024; Damanik, Widodo, 2024), providing new opportunities for assessment (Niclòs et al., 2024) and quality feedback (Wang, Lee, 2024; Damanik, Widodo, 2024), and promoting innovative learning environments for collaboration (Graessler, Taplick, 2023; Damanik, Widodo, 2024; Nichols, 2024). Furthermore, equity in access to technology is vital to help all participants of a learning process reach their full potential (Gabriel et al., 2022). For this reason, integrating digital technologies must align with systems-level approaches that promote inclusivity and support

diverse learners. Also, as curricula evolve toward technology-enriched classrooms, educators must balance their subject proficiency with the ability to facilitate individual and collective learning opportunities (Nichols, 2024).

Digital tools provide the power to break the borders of historical approaches (Szostak, Sułkowski, 2024) in art education. The pandemic due to COVID-19 accelerated the process of digitalization and caused dramatic changes in approaches among creators and representators at any age for creating and presenting artwork (Fernandez, 2019; Wang, Lee, 2024; Xia et al., 2024). Research indicates that the results of the process, such as online exhibitions, web resources, and digital libraries become good tools for learners (Wang, Lee, 2024), as well as connecting bridges between creators and lovers of art (Xia et al., 2024). Adapting digital tools in art classes by teachers led to emerging new materials and teaching methods (Tong, 2024) also leading to the active participation of students (Szostak, Sułkowski, 2024). Nichols (2024) argues that since creating digital art involves a complex process of accurate visual representation of a digital image using a computer and having skills in traditional methods of visual arts at the same time, digital art skills make the creator a well-rounded artist. On the other hand, research has shown that if the student has inadequate digital skills in the learning environment, it could lead to limitations in creativity and innovation when the student starts to work at school (Tusiime et al., 2020).

Furthermore, considering that students in schools will become different specialists in the future, art teachers should focus on preparing young talents with a high level of innovation for society (Wang, Lee, 2024) by utilizing digital art in education, as it has a positive impact to students' creativity (Tusiime et al., 2020).

2.3. Creativity and digital creativity

As an important part of art education (Wang, Lee, 2024), creativity is defined as a process of producing and improving innovative, distinctive, original, effective, and practical ideas (Graessler, Taplick, 2023; Wang, Lee, 2024; Maor et al., 2024; Xia et al., 2024; Tong, 2024). Nichols mentioned micro and macro levels of creativity. While the "Microlevel" is related to the periods when students begin to create, the "Macrolevel" is more evident in the work of artists who go through the full creative process (Tusiime et al., 2020).

When creativity meets digital tools, digital creativity emerges (Rensburg et al., 2021; Wang, Li, 2022). Digital creativity involves technology for thinking, creating, and producing new materials and encompasses several fields such as multimedia and digital art (Rensburg et al., 2021; Wang, Li, 2022). It already has become one of the drivers of the digital world (Wang, Li, 2022).

2.4. How do digital tools foster creativity?

Digital tools influence the creativity of students through emotional and cognitive engagement in learning, collaboration and allow creators to break boundaries of time and space (Wang, Li, 2022; Weng, Chiu, 2023; Wang, Lee, 2024). Studies have proven that providing engagement and interactivity by using digital media tools develops more ideas and creative expression, and even improves learning outcomes (Wang, Li, 2022; Weng, Chiu, 2023; Wang, Lee, 2024; Tong, 2024). Appropriate use of digital tools, in the form of software, hardware, and platforms empowers students to manipulate various mediums (Tong, 2024). Most of the researchers mentioned students and teachers use software such as Adobe Photoshop, Adobe Illustrator, Blender, and Maya; hardware such as Wacom, and iPad; and immersive technologies such as VR and AR (Graessler, Taplick, 2023; Wang, Lee, 2024; Nichols, 2024) for the creation of products in different dimensions. Such tools have unlimited potential to expand the borders of creativity by allowing users to do innovative experimentation (Tong, 2024), manipulate, create, and enhance images (Nichols, 2024), explore new ways of art creation (Wang, Lee, 2024), be interactive (Graessler, Taplick, 2023), share and display fast and easy (Wang, Lee, 2024). This opportunity reflects apparently where teaching creatively meets teaching creativity – in art education. Advanced digital tools have already started to transform the field of painting and provide more space for students to enhance their creative potential (Wang, Lee, 2024). Černochová & Selcuk (2020) also highlight the cyclical nature of creativity and digital literacy not only enhances digital skills but also unleashes students' creative potential.

2.5. Importance of creativity in teacher education.

Creativity is one of the important constructs that are key to the educational process and curriculum in the world (Wang, Li, 2022; Weng, Chiu, 2023; Maor et al., 2024; Niclòs et al., 2024; Zana-Sternfeld et al., 2024). Creativity in teacher education requires a complex approach, encompassing the interconnection between creativity and knowledge, curriculum, and suitable

pedagogical techniques for nurturing creativity within classroom (Zana-Sternfeld et al., 2024). In the technological age creativity in education refers to using various teaching methods, including utilizing technology in class (Tong, 2024). Research has shown that fostering creative thinking in a learning environment reflected positively in working spaces (Tong, 2024) and greatly influenced the quality of learning (Damanik, Widodo, 2024).

Fostering creativity in education necessitates a synergistic relationship between teachers, students, and technology. Research by Damanik & Widodo (2024) mentions the mutual influence between creative teaching practices and teacher professional development.

Two types of creativity are mentioned in education: teaching creatively and teaching for creativity (Maor et al., 2024). Maor et al. (2024) insists teaching creatively involves employing diverse learning strategies that stimulate curiosity and enhance efficacy through numerous instructional methods, including video, animation, and graphics, to accomplish educational goals. Teaching creativity refers to educators' ability to reinterpret innovative notions into methods, strategies, tactics, formats, and resources for instructional activities throughout the learning process (Damanik, Widodo, 2024). Moreover, Zana-Sternfeld (2024) noted creativity is important to fulfill educational needs.

However, current educational frameworks inadequately prioritize creativity, and educators lack support in translating principles that advocate creativity into practical applications. The solution can be reached by raising awareness among educators (Niclòs et al., 2024) and equipping teachers with adequate knowledge (Maor et al., 2024) regarding creativity.

3. Methodology

3.1. Research Design

This study used a mixed-methods approach, specifically a convergent parallel design, in which quantitative and qualitative data were collected simultaneously and then integrated during the interpretation stage. This design was chosen to ensure triangulation of evidence: the survey provided a broad overview of student experiences, while interviews and classroom observations offered in-depth qualitative insights.

3.2. Participants

The study was conducted with the participation of five teachers and sixty-nine students. Teachers were purposefully selected based on two criteria: (a) their direct engagement in creative processes, and (b) their active use of digital technologies in classroom instruction. Student participants, in turn, were included according to two considerations: first, their voluntary agreement to participate in the study; and second, their enrollment in degree programs directly connected to art pedagogy. This selection ensured that both the teacher and student groups were meaningfully positioned within the research focus on digital tools in art education. The sampling procedure followed a convenience approach; however, efforts were made to ensure representation from different year groups and specializations, which allowed us to capture a broad spectrum of student experiences. A sample of 69 participants was deemed sufficient for the purposes of this case study, as it provided the basis for identifying key trends and enabled statistical analysis at the level of a single institutional context. Although the sample size may be considered modest, it represents a substantial proportion of the student population in the given setting and thus offers reliable data for both qualitative and quantitative interpretation. It is also worth noting that the sample size used in this study aligns with norms in comparable research within art pedagogy and related educational fields. In studies exploring the impact of the arts in education, sample sizes have often ranged between 24 and 133 participants, with many falling around 60–70 respondents, which has been shown to be sufficient for detecting meaningful effects when appropriate statistical methods are applied (Schneider, Rohmann, 2021). Accordingly, the participation of 69 students can be considered well-justified in terms of ensuring the validity and informativeness of the findings on the integration of digital tools in art education.

3.3. Data Collection Methods

We used multiple data collection methods to ensure data integrity, accuracy, and openness.

3.3.1. Lesson Observations.

In order to explore the practical use of digital tools in the classroom environment, observations were made in ten separate art classes over two weeks. The observational framework was developed with specific criteria, such as:

– Which kind of digital tools are used in practice (e.g., graphic design programs, online collaboration platforms)?

– How are the lessons engaging: with and without digital tools?

– Is communication between students and professors interactive?

Each observation session lasted approximately 90 minutes, and detailed field notes were taken according to the criteria.

3.3.2. Surveys.

The survey was designed to capture students' perceptions of digital tools used in art education and to collect quantitative data on this. The quality of this diagnostic instrument was ensured through several stages of validation: determining content validity and verifying its accuracy and relevance through an expert review with faculty members specializing in art education. We then pilot-tested the survey with a small group of students (n = 10) to confirm the accuracy, comprehensibility, and consistency of responses, leading to minor adjustments to spelling and vocabulary. Consequently, factor analysis was carried out to examine construct validity, and the results confirmed that the elements coherently grouped into the intended — students' perceptions of digital tools, their influence on creativity, and overall satisfaction with the use of technology. Reliability was tested using Cronbach's alpha, with values between 0.78 and 0.83, indicating strong internal consistency. Overall, these steps provided us with strong evidence about the instrument's validity and reliability for use in this research.

3.3.3. Interviews.

Semi-structured interviews were conducted with a targeted sample of five faculty members actively utilizing digital tools in their classes. The discussions aimed at examining the experiences, difficulties, and advantages participants faced while utilizing technology in arts education. Each interview lasted approximately 20–30 minutes and followed a guiding protocol covering three key domains: (1) Art and Creativity, (2) digital tools in art education, and (3) the role of digital tools to foster creativity. The semi-structured format allowed for consistency across interviews while also providing flexibility for participants to elaborate on individual experiences. With consent, all interviews were audio-recorded and subsequently transcribed verbatim to ensure accuracy of analysis.

3.4. Data Analysis

The thematic analysis was conducted on qualitative data obtained from lesson observations. Recurring themes concerning student engagement and creativity were recognized, and these were subsequently categorized to underscore best practices and potential improvement areas in integrating digital tools.

Interviews were recorded in audio format (with participants' permission) and transcribed word-for-word for analysis. Thematic analysis was utilized to uncover significant themes concerning improving creativity via digital tools. A thematic analysis approach was applied to the interview transcripts following Braun and Clarke's six-phase framework. First, transcripts were read repeatedly to ensure familiarity with the data. Second, initial codes were assigned to meaningful text segments and grouped into broader categories. These categories were iteratively refined into overarching themes and subthemes. Coding was independently reviewed by two researchers, and discrepancies were resolved through consensus, ensuring reliability.

The resulting themes and subthemes are presented in Table 1.

Table 1. Themes and Subthemes from Interview Analysis

Category	Themes	Subquestions
Art and Creativity	*What is the ART* *What is creativity* *Ethical issues (borders) in creativity* *What kinds of creativity do students have in art education?*	*– Which work do you consider as an ART? (Your own opinion);* *– Examples from your class* *– How do you evaluate the work of students as creative;* *– Are there any criteria?* *– As an artist and as an educator of art*

Digital tools	*Integrated digital tools*	
Role of digital tools in fostering creativity	*Role of digital tools to foster creativity* *Assessing the impact of digital tools on students' creative output*	*How are these tools being used to encourage students to create, design, or innovate? Do you use digital tools for this process?*

Quantitative data extracted from surveys were examined using descriptive statistics to summarise participants' responses. Almost all answers were in Slovak, so they were translated into English, and where responses were long, they were summarised and generalized into topics. Moreover, inferential statistics were employed to determine connections between the utilization of digital tools and students' creativity levels.

3.5. Case Study Setting

The case study was conducted at the Department of Creative Arts and Art Education within the Faculty of Pedagogy at Constantine the Philosopher University in Nitra (NKF), Slovakia.

3.5.1. Overview of the Department of Creative Arts and Art Education.

The department was established in 1960 when it was separated as an independent workplace from the Department of Art Education and Fundamentals of Industrial Production. The curriculum integrates both traditional artistic techniques and contemporary digital practices. The priority professional area of the department is research focused on didactic-methodological issues of training art teachers, which includes questions from the theory of teaching, specific problems of visual communication, and exegetical interpretation of a work of art with a focus on active work with works of art and verbal communication.

The Department is well-equipped with modern technological resources that support the integration of digital tools into art education. They have two computer labs provided with hardware for digital drawing and access to the Internet. The conditions created and the digital art projects implemented in the department can provide a very favorable environment and the necessary conditions for the case study.

4. Results and Analysis

In Phase I of the case study, we investigated prior experience, the purpose of the usage, and the perceptions of teachers and students in the department about integrating digital tools. The process involved lesson observations, interviews, and a survey among students. For the observation, different technology-related subjects such as Digital media in education, Intro to digital media, IT and Art, Creating Video-photo, Digital photography, and art-related subjects such as Didactics at school, Methodic in Art education, Book design, Intro to visual arts, and Textile design were chosen. Five faculty members were involved in the interview.

Observations and interviews revealed that all classes and teachers use the internet, video, social media, and browsing during class. However, students and teachers only use software in technology-related subjects, and a limited number of classes include digital tools for collaborative or interactive activities during class.

4.1.Results of the survey: Phase I.

The survey participants were mostly art or art-combined major students (Figure 1a) of different ages (Figure 1b) and levels of study (Figure 1c).

4.1.1. Prior Experience of Students with Digital Technology

The data revealed that a significant portion of participants (91 %) were familiar with digital tools at a different level, while a small number reported they had not experienced it (9 %). In detail, 47 students have used tablets, indicating it's the most common digital tool among the students, 55 students have experience with graphic design software, 15 students have used 3D modeling software, and 4 students have VR. One participant, even having a piece of basic knowledge, has not used any digital tools for a long time. On the contrary, the students, who considered themselves not experienced, tried to use a certain digital tool (Table 2).

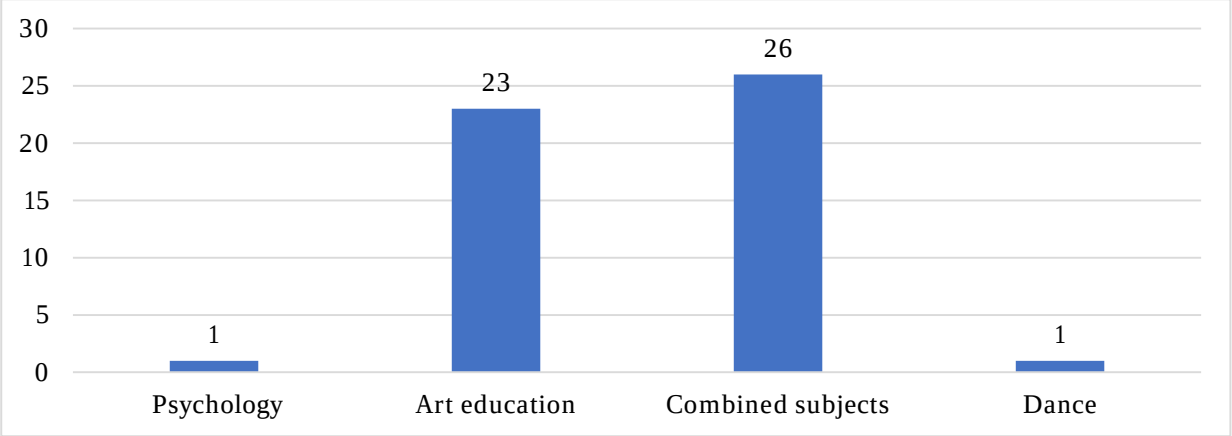

Fig. 1a. Demographics of participants: Majoring (Phase I survey)

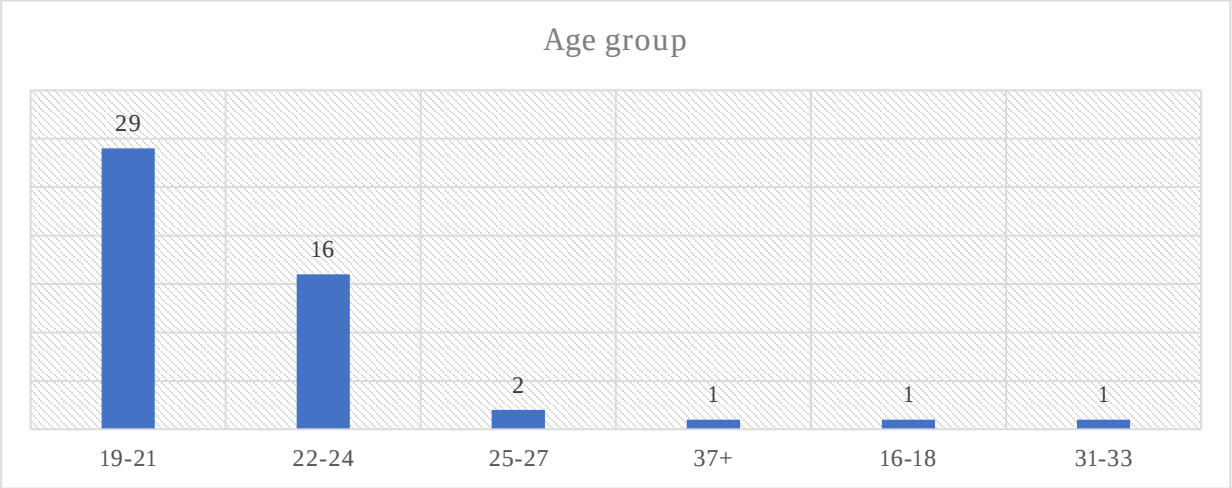

Fig. 1b. Demographics of participants: Age group. (Phase I survey)

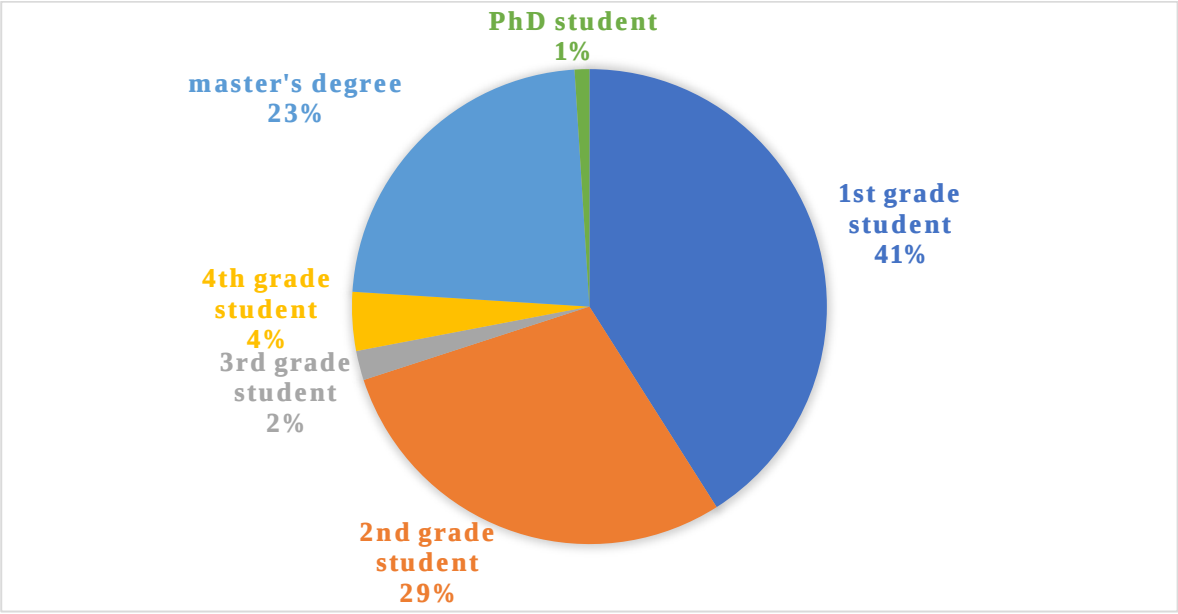

Fig. 1c. Demographics of participants: Grade level (Phase I survey)

Table 2. Levels and prior experience of participants with digital tools

Levels	Number of students	Prior experience				
		Tablet (e.g.: iPad)	Graphic design software	3D modeling software	VR	Did not use
Advanced	11	10	10	7	0	0
Intermediate	25	16	22	7	2	0
Basic	28	17	22	1	2	1
Low	5	4	1	0	0	0
Grand Total	**69**	**47**	**55**	**15**	**4**	**1**

4.1.2. Frequency and Purpose of the usage in formal and informal cases.

The predominant purpose of using Digital tools was for Digital art (68), Graphic design (54), and Learning (39) both within and outside educational settings. Students who created digital artworks mostly mentioned sketching, drawing, painting, comics, illustrations, and designs for printing materials. Graphic design creators used software for photo editing, restoring, animation, and creating posters. Students who used it for earning purposes mostly created presentations and searched for information.

Notably, the overall use of technology was significantly higher in outside-of-school settings than in the lessons. Interestingly, digital tools were used for leisure activities in students' free time, with communication as another prominent purpose (Table 3). It could be concluded that the appropriate integration of digital tools into the educational process should be investigated, considering users' interests and aspirations to use technology.

Table 3. Usage of digital tools in and out of school cases

Purposes	In-school usage				Out-of-school usage					Total
	daily	often	sometimes	rarely	daily	often	sometimes	rarely	do not use	
Graphic design	1	14	13	8	11	7	0	0	0	**54**
Digital art	3	19	13	8	20	3	0	2	0	**68**
Learning	0	7	4	6	17	4	0	1	0	**39**
Communication	0	0	0	0	11	4	0	0	0	**15**
Earning	0	0	0	0	2	2	0	0	0	**4**
Leisure	0	0	0	0	27	8	1	2	0	**38**
Do not use	0	0	0	0	0	0	0	0	3	**3**
Total	**4**	**40**	**30**	**22**	**88**	**28**	**1**	**5**	**3**	

4.1.3. Student Perceptions of Digital Tools

Regarding perceptions of students whether digital tools can enhance their creativity and innovation, most of them agreed. However, it is notable that the number of strongly agreed students was less than those who just agreed. Moreover, the number of neutral students is also

noteworthy (Table 4). It can be concluded that despite the agreement on the impact, students have doubts about digital tools and their effectiveness in creativity.

Table 4. Perception of students about the impact of digital tools to enhance creativity

Labels	Amount
Strongly agree	22
Agree	31
Neutral	15
Strongly disagree	1
Grand Total	**69**

Their answers to the question "How innovative do you feel your digital art projects are compared to traditional methods?" also supported this idea. From Figure 2 we can see that the highest number of respondents evaluated the effectiveness of digital tools at the middle level.

Moreover, interviews also supported these results. Most of the teachers argued that Digital tools are undoubtedly useful and impact creativity in art education; however, they are not yet developed enough to unlock students' full potential in terms of creativity.

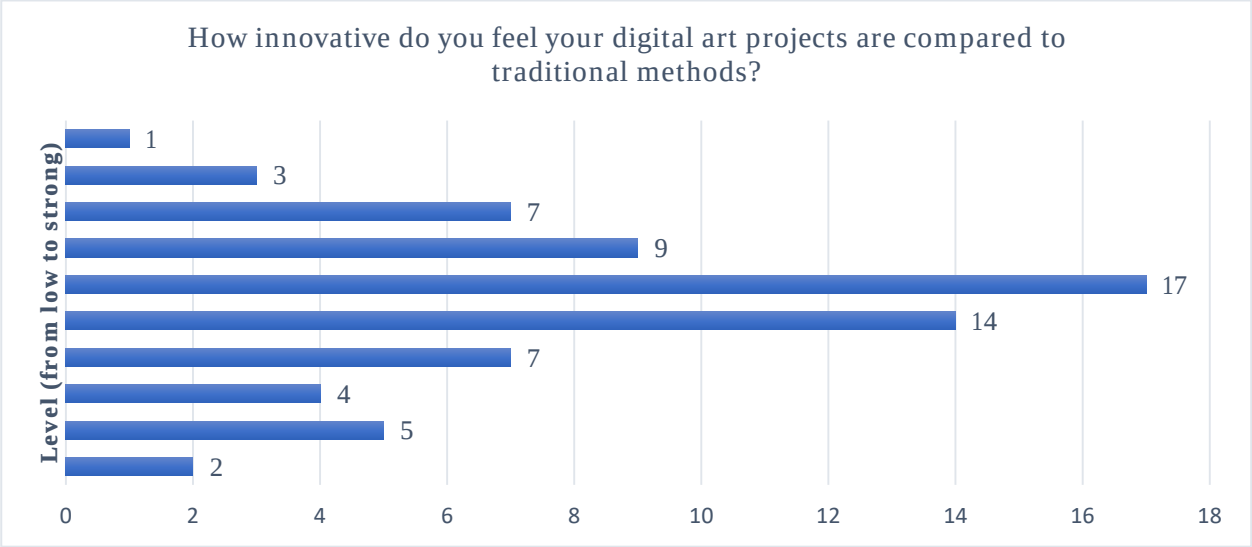

Fig. 2. Perception of how digital tools are innovative compared to traditional ones

In the following answers, students supported their agreement or disagreement (Table 5a and 5b). Results revealed that most students believe that digital tools are beneficial for creativity (27), and learning (13). While some students think such tools are useful for inspiration (6), collaboration, and feedback (3), only a limited number prefer them as they offer unlimited possibilities to create (2) and they are good sources for idea generation (1).

On the contrary, a few students hold negative views about using digital tools for creative purposes. Two of them think that digital tools are only practical, while one claims they are not interesting, and another prefers traditional methods rather than digital ones.

In the survey, students were asked which digital tools they had used recently to explore what software they use in actual practice.

Photoshop and Illustrator are the most prevalent digital art tools among the surveyed individuals, with 18 and 8 choices respectively. InDesign and Rebelle followed them with 5, while GIMP and CorelDraw are used by a smaller group of 4 and 3 respondents respectively. The remaining tools, including Procreate, Clip Studio Paint, Lightroom, SAI, Sketchbook, Autodesk Sketchbook, Leila, PowerPoint, Ad Fresco, Medi Bang Paint, Pixel R, Flash, and Cinema 4D, are used by 2 or fewer respondents each (Figure 3).

Tables 5a and 5b. Students' positive (a) and negative (b) insights about the influence of digital tools on creativity

Table 5a.

Levels	Reasons						
	Useful in Creativity	For idea generation	Learning	Inspiration	Collaboration and feedback	Unlimited possibility	No reason
Strongly Agree	5	1	1	0	0	1	0
Agree	15	0	12	4	3	0	1
Neutral	7	0	0	2	0	1	12
Total	27	1	13	6	3	2	13

Table 5b.

Levels	Reasons			
	Not interesting	Only practical	The traditional approach is better	Did not help
Do not agree	1	1	1	0
Strongly disagree	0	1	0	1
Total	1	2	1	1

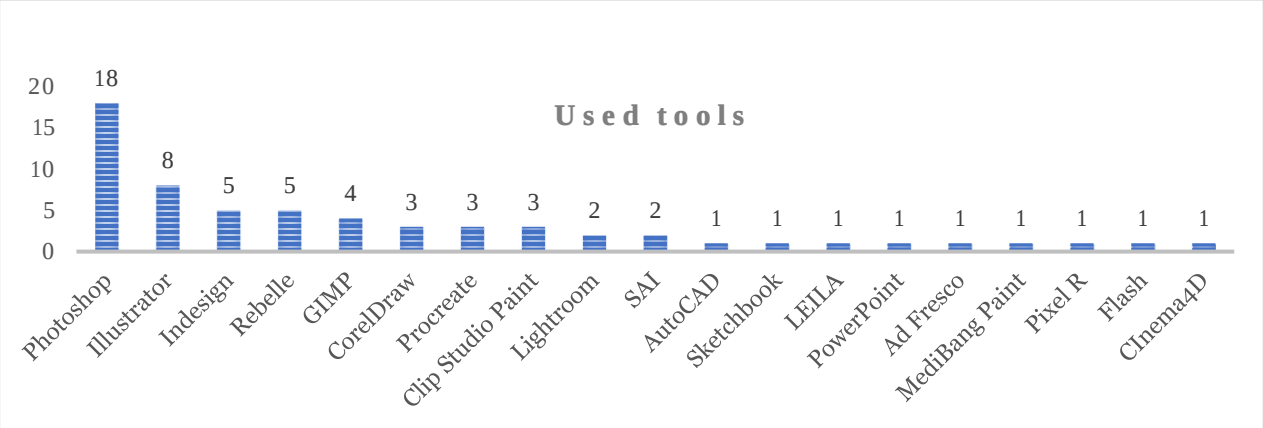

Fig. 3. Previously used software by students

The observation and interviews with faculty members supported the survey's findings. While teachers mentioned Photoshop, Illustrator, and InDesign as more effective tools for Graphic design and Book illustration, Rebelle was the most preferable software for resembling traditional art in digital space.

Participants' overall perceptions of integrating digital tools into art education were mostly average (Table 6). They think technologies provide an opportunity to experiment with a variety of materials without waste (57) and access to a greater range of tools and resources (55), helping to instant feedback (21) and collaboration (11).

Table 6. The overall perception of integrating digital tools into art education

Levels	Reasons			
	Accessibility to a greater range of tools and resources	**Experiment without wasting materials**	**Instant feedback**	**Collaboration**
Excellent	6	6	5	0
Good	19	21	7	4
Average	23	20	8	5
Bad	7	10	1	1
Total	**55**	**57**	**21**	**11**

4.2. Phase II: Implications and Outcomes

Class observations, Phase I surveys with students, and interviews with teachers have revealed digital tools in art education are not only about creating artwork on display but also about creating engaged classrooms during the lesson. According to Tables 2, 3a, and 4, students prefer to use digital tools for collaboration and feedback besides painting and drawing. Therefore, in Phase II students were given a task preparing a presentation about any topic related to the subject. The task focused on experimenting with improving their collaborative, innovative, and digital creativities which are necessary for their future career. Overall, 22 students were involved in the process as they used digital tools actively throughout the classes.

All presentations involved some kind of digital tool for engagement and interactivity. The most used examples were 360^0 videos, QR codes, and interactive games prepared on Kahoot, Canva, Mentimeter, and AhaSlides.

“Digital tools helped to increase my creativity by inventing the design of the presentation and the method of execution.” – Hana Duricova, 1st grade student in the Department of Creative Arts and Art Education.

All students mentioned that using tools helped to make the presentation more engaging, especially when the class was involved in interactive games.

“It helped me to spark interest in the class and concentrate the attention of my classmates through games, and it increased my collaborative creativity...”-Yelena Zolotarova, 1st grade student in the Department of Creative Arts and Art Education.

The results suggest a generally positive perception of digital tools for engagement, collaboration, and impact on creativity, with scores predominantly ranging from 7 to 10 on a scale (Figure 4).

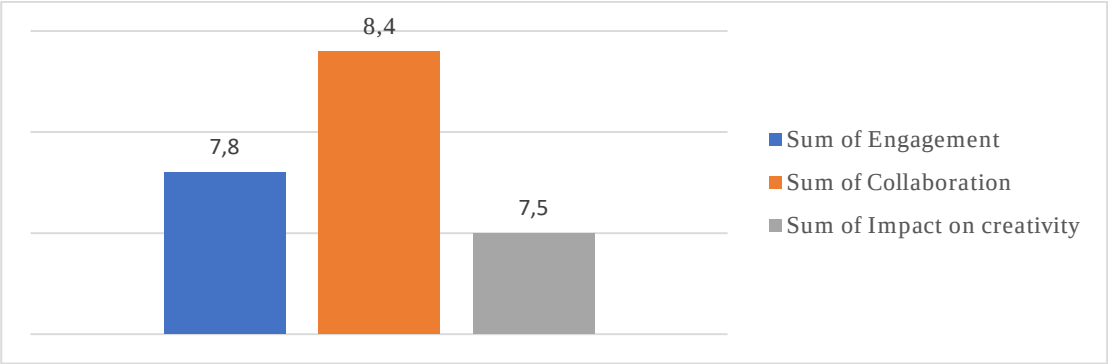

Fig. 4. Overall satisfaction of students on the impact of digital tools

4.3. Challenges in the integration of digital tools into Art Education.

Observations, surveys (in both phases), and interviews argued the significant challenges are related to technological, financial, and educational issues.

The most significant challenge, with 31 students raising concerns, lies in the area of literacy. Students expressed extra time for mastering the tools, being careful of plagiarism, constant effort to keep the current level or improve the knowledge, keeping a balance between technology and traditional methods, having a quality teacher, and dealing with technology.

A significant number of students reported financial constraints as a barrier. The reasons included the difficulty of affording digital tools and the financial demands of using subscribed software versions.

Likewise, some students indicated technological issues such as crashing in unexpected moments, having quality Internet, and using updating tools (Table 7).

Table 7. Challenges in the integration of digital tools

Category	Number of students	Specific reasons
Literacy	31	Requires extra time to learn; Prone to plagiarism; Constant efforts; Keep a balance between digital and traditional creativity; Lack of professional teachers in this field; Deal with technology;
Financial	13	Not anyone can afford a digital tool (personal or at school); expensive subscription to programs
Technical issues	10	Unexpected crash of the software; Access to the Internet; Updating tools;
I do not know	9	Can not explain
None	2	Can not explain

4.4. Summary of Key Findings

4.4.1. Quantitative Results

A series of chi-square (χ^2) tests were conducted to examine the significance of relationships in the data:

Proficiency level and Prior tool use (Table 2`). $\chi^2(9, N = 69) = 13.80$, $p = 0.129$. No significant association was found between students' level of proficiency and the types of digital tools they had previously used.

Purpose of use and Frequency of use (Table 3). $\chi^2(6, N = 69) = 7.87$, $p = 0.248$. No significant relationship was identified between students' reasons for using digital tools (graphic design, digital art, learning) and their frequency of use.

Attitudes toward digital tools (Table 4). $\chi^2(3, N = 69) = 19.12$, $p < 0.001$. Students' responses were not evenly distributed, with "Agree" (31) and "Strongly agree" (22) being significantly more frequent than expected under uniform distribution.

Phase I and Phase II comparison (Creativity and Collaboration).

Comparing students' initial expectations (Table 5a, 5b) with their subsequent evaluations (Figure 4), a clear shift can be observed. In Phase 1, creativity (n = 27) and learning (n = 13) emerged as the dominant reasons for using digital tools, whereas collaboration (n = 3) and feedback (n = 3) were mentioned only rarely. In Phase 2, however, experimentation (n = 57) and access to a broader range of tools (n = 55) were identified as the most salient benefits, while collaboration (n = 11) and feedback (n = 21) gained much higher recognition compared to the initial phase. Negative reasons were minimal in both phases (Phase 1: n ≤ 2; Phase 2: "Bad" = 7), confirming the overall positive perception.

4.2. Qualitative Results: Interview Findings

Analysis of five semi-structured interviews with teachers revealed consistent understandings of the integration of digital tools into arts education and emerged four main themes – creativity

and experimentation, engagement and motivation, barriers and challenges, and needs for institutional and professional support.

Creativity and experimentation. It was also found that digital tools can play an important role in expanding opportunities for creativity and expression by allowing students to utilize new media without fear of mistakes or material waste. This freedom led to encouragement for innovation and the exploration of new artistic directions.

"Creativity is an approach to solve a problem unusually when the usual way does not work." — **PaeDr. Janka Satkova**, head of the Department of Creative Arts and Art Education.

Engagement and motivation. Motivation, as well as engagement, was consistently observed among students during the lessons when digital tools were incorporated into the learning process. Tablets, design software, or digital platforms made the lessons more dynamic, leading to active participation and enthusiasm.

"Lessons with digital technologies were more dynamic, and students showed visibly higher interest." — **Adriana Recka,** Assoc. prof., PhD.

Barriers and challenges. Instructors pointed out some difficulties in the integration process. It includes lacking of digital tools, insufficient training, and sometimes, students' objections to the digital approaches were most often mentioned as an obstacle to successful integration.

"Some students still prefer traditional methods and hesitate to use technology, which slows down the process." — **Lubomir Zabadal,** PhD.

Support needs. Another notable topic was the value of institutional and professional support. Instructors elaborated on support around and the organization of advanced training, workshops, and continuous methodological support required to ensure sustainable integration of digital tools into everyday teaching practice.

"Workshops are helpful tools for teachers in order to integrate them more effectively and make better use of the available resources." — **Jan Hunady,** PhD.

RQ1: What are the prior experiences and perceptions of teachers and students in the department regarding integrating digital tools in art education?

The research findings show that students have prior knowledge of digital technologies and how to use them in creative processes regardless of a medium. However, most of their experiences had primarily to do with using the instruments as artists and not using them in teaching. This showed a disparity between how tools are used now and the ways they could be used in teaching.

Faculty Insights: Views of the Faculty The faculty's feelings about the use of digital tools were somewhat contradictory. Although they pointed out the need for merging the tools in the teaching part, they argued that it could improve the creative aspects of art.

RQ2: What specific digital tools are used and perceived by students as effective for creativity in visual arts education?

It was identified effectiveness of several digital tools for fostering creativity in visual arts education, such as:

– Graphic design software (e.g., Adobe Creative Suite)

– Digital art applications (e.g., Rebelle, GIMP)

The results suggest integrating various digital tools into art education curricula is beneficial to build creativity and innovation skills among future educators.

RQ3: Which digital tools should be integrated into the educational process to build future visual arts teachers' creativity and innovation skills as educators?

Research shows that future art teachers will need to gain organizational skills as well as artistic creativity during their study. Such skills include, but are not limited to, collaborative, innovative, and digital creativity. Therefore, integration of instruments that are intended to foster interactivity and collaboration is crucial.

RQ4: What are the potential challenges and limitations associated with integrating digital tools in art education?

A notable challenge was the lack of access to suitable materials as a result of financial issues. It was emphasized that a substantive percentage of students can only afford to purchase only basic digital hardware and software.

As a result, there is a lack of teaching approaches that support the fusion of technology in teaching and learning art, which may impact the teaching of digital skills. Furthermore, some learners were reluctant to engage in the use of digital technologies because of the doubts that were raised regarding the effectiveness of these tools in enhancing creativity.

5. Discussion

In summary, digital tools' positive impact in the field of art education have been emphasized among different student categories, contexts, and art sub-disciplines. The low statistical significance in Tables 1 and 2 proved that benefits were not restricted to a few student subgroups nor to select purposes of use, which suggests a more widespread distribution within the balance of the general population.

Perhaps more telling is the overwhelming student response to the role of digital tools in boosting creativity which is backed by strong statistical significance within Table 3. This particular finding aligns with the most recent literature that digitally driven pedagogies within arts education have the potential to actively stimulate innovation and creativity.

Furthermore, the comparison between Phase I and Phase II results ($\chi^2(1, N = 86) = 0.20$, $p = 0.654$) demonstrates a high degree of consistency: the expectations expressed by students at the outset regarding creativity and collaboration were confirmed by their reported experiences. This consistency reinforces that the research is based on the right approach and highlights that the perceived benefits of digital tools are indeed effective in practice.

Considering the findings of the study, it is noted that the use of digital tools in art education enhances students' creativity and engagement. This study also indicated that the use of digital tools in preparing art teachers has a positive correlation with students' creativity, engagement, and willingness to take risks with their work. These findings align with recent research that investigated the intersection of digitalization and creativity. For instance, in a study carried by Wang and Li (2022), it was confirmed that digital tools in STEM education improved students' creative thinking skills, which is similar with our findings, whereby creative thinking and experimentation were the most reported benefits by the students. Similarly, Janse van Rensburg, Coetzee, and Schmulian (2021) argued that digital assessment can foster creativity; their findings are also supported by our study, in which students reported that the use of technology fostered creative expression.

The relationship between nurturing digital skills and fostering creativity is also seen in Wang and Lee (2024). Research showed a relationship between digital competency and creativity of students in the visual arts, and this aligns with our findings, which demonstrate that students who are exposed to using digital tools can produce artworks that are much more original. At the same time, the structural support mentioned in the interviews is consistent with Tusiime, Johannesen, and Gudmundsdottir (2020), who reported that teacher educators in Uganda had to struggle with infrastructural and pedagogy problems while teaching art and design in the digital world. Similarly, our data described the inadequacy of resources and the absence of training.

From the interviews, the participants emphasized collaboration and feedback on digital engagement, which is similar with ideas of Fernandez (2019), who claimed that including collaboration in the educational system of higher education can foster inclusion and shared learning activities. Also, Zhang et al. (2024) demonstrated that educational digitalization improves some aspects of creativity of students with special needs through creative self-efficacy. Likewise, feedback and collaboration through digital tools can support various learner dispositions, which our study reinforces.

The results also echo Spante (2019), who emphasized the importance of digital storytelling and creative production as effective methods for fostering digital creativity. In our study, both students and teachers emphasized the importance of experimentation and active engagement with digital media for learning. Furthermore, the emphasis on institutional and professional support in our findings aligns with the findings of Gabriel et al. (2022), who documented how global digital education strategies depend on well-designed policies and institutional practices.

At the same time, the study offers new insights by demonstrating how students' initial expectations regarding creativity and collaboration (Phase I) were confirmed by practice (Phase II). This consistency not only confirms the more general findings of Haleem et al. (2021), who examined the positive educational role of digital technologies, but also expands the literature by demonstrating the growing recognition of the benefits of collaboration in real-world classroom practice.

6. Conclusion and recommendations

This study demonstrates that integrating digital tools into arts education consistently fosters student creativity, experimentation, and engagement across diverse groups and contexts. Statistical analysis confirmed high levels of student support for digital technologies, and a comparison between Phases I and II demonstrated that initial expectations regarding creativity and collaboration were realized. The results are consistent with previous research emphasizing the role

of digital media in fostering innovation and highlighting the growing importance of collaboration and feedback as additional benefits. Although the small sample size limits generalizability, the results strongly suggest that digital technologies represent a valuable resource for fostering both individual creativity and collaborative learning in arts education.

Based on the results of this study, several practical and scientifically based recommendations were developed:

– Creative experimentation should be supported. It is important to provide wider access by institutions to diverse resources related to digital creativity in order to encourage exploration, facilitate trial-and-error learning, and give an opportunity for innovative artistic expression.

– Strengthen collaborative opportunities. Digital platforms should be expanded by facilitating peer-to-peer collaboration, offering group projects, and creating structured feedback processes, as the benefits of these crucial aspects have emerged in Phase 2.

– Invest in teacher training. Educators should be empowered through sustained professional development programs focused on pedagogical strategies that incorporate the integration of digital technologies into the arts education.

– Address technical and institutional barriers. To fully enable digital integration, educational institutions must provide the essential technical support, provide broader material and technical base, and offer institutional support required to reduce systemic obstacles.

– Future research. Future studies should include larger, more representative samples and, perhaps, explore in more depth how digital tools influence not only individual creativity but also collaborative learning methods in arts education.

Furthermore, classroom observations have shown that digital tools are ineffective in fostering creativity and engagement if they span the entire lesson. In such cases, this can lead to students feeling resistant to technology. Therefore, physical and digital activities should be balanced in the learning process.

7. Limitations of the study

It is important to note that the relatively small sample size (N = 69) and the non-random nature of the participant selection represent some limitations of this study. These factors limit the generalizability of the findings, as they primarily reflect the conditions of a single institution and may not be representative of all art education contexts. Furthermore, the use of a contingency sample may introduce some bias, as more motivated or digitally literate students may have been overrepresented. These limitations should be taken into account when interpreting the results. Future studies should consider increasing the sample size, diversifying institutional settings, and using probability sampling methods to increase representativeness and external validity.

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