

Analysing university art curriculum through descriptive geometry in AutoCAD

*Aidar **Kuzdeubayev**¹, Karim **Baigutov**¹, Medetbek **Abdirassilov**², Azat **Abdrassilov**²,
Yerzhan **Ryssymbetov**³ & Sarsengali **Bekeshov**⁴

¹Abai Kazakh National Pedagogical University, Almaty, Kazakhstan.

¹Abai Kazakh National Pedagogical University, Almaty, Kazakhstan.

²M.Kh.Dulaty Taraz Regional University: Taraz, Kazakhstan.

²M.Kh.Dulaty Taraz Regional University: Taraz, Kazakhstan.

³Akhmet Yassawi International Kazakh-Turkish University, Turkistan, Kazakhstan

⁴Kazakh Leading Academy of Architecture and Construction, Almaty, Kazakhstan

***Corresponding author:** akuzdeubayev08@gmail.com

Abstract

The study aims to investigate the incorporation of descriptive geometry and AutoCAD into the art education in order to enhance students' technological and artistic-creative skills. A mixed-methodology comprised of focus groups with students, document analysis of arts classes and student artworks, semi-structured interviews with art teachers, and survey questionnaires was adopted for the study. The results show that AutoCAD is increasingly being integrated into the curriculum and is primarily used for 2D and geometric designs. Although students recognized its technical proficiency and design advantages, they struggled with its steep learning curve and technical bugs. Teachers also encountered several challenges in incorporating AutoCAD into their teaching, such as limited access to the software, the need for specialized training, and the necessity to adapt their teaching methods. But despite these hurdles, both educators

and students lauded AutoCAD's precision, attention to detail, and potential to boost job readiness. According to the study, it is important to deal with technological barriers and make sure that digital tools are accessible, and to prepare teachers. This indicates that basic software such as AutoCAD can change art learning approaches by having students engage in creative thought processes and gain the same skills as required in the industry. Therefore, further investigation of the influence of digital tools on students' creativity and career prospects, as well as strategies to improve the effectiveness of their implementation in the process of education, should be a focus of future research.

Keywords: Art education, AutoCAD, descriptive geometry, digital tools, student creativity.

Introduction

Technology has transformed traditional classroom lessons, especially in subjects where pupils learn best visually and spatially. Digital technology like AutoCAD has improved numerous sectors, including university art curricula. Despite its broad use in the physical world, AutoCAD has significant potential to enhance art education by establishing the framework for descriptive geometry. Descriptive geometry, which allows two-dimensional depiction of three-dimensional things, may help students understand and evaluate art. Art programs have always aimed to develop students' imaginations, skills, and aesthetics. The integration of AutoCAD-based descriptive geometry into the curriculum may expose pupils to more spatial thinking and precision. This integration aligns with the current educational trends and prepares students

for future occupations that need digital design skills.

Numerous studies have explored the impact of technology on education, focusing mainly on various aspects of this relationship. Some studies have specifically examined the interaction between teachers and technology, categorizing the influential factors in this dynamic (Shiri & Baigutov, 2024a; Peñín et al., 2004). However, existing research on the effects of digital technologies on students' creativity presents divergent perspectives. While some studies argue that digital technologies have no significant impact on the creativity of art students, others suggest that these technologies enhance engagement and participation. This, in turn, can serve as a supportive tool for fostering creativity in art education by providing students with

opportunities and resources that facilitate the generation of innovative ideas (Zakaria et al., 2012; Nkomo et al., 2021; Shiri & Baigutov, 2024b). Liu et al. (2021) found that digital design tools in art classes increased students' enthusiasm and creativity. The study found that AutoCAD gives pupils more design and spatial thinking practice than other methods. As Cumino et al. (2021) found, 3D modeling software in art classrooms may assist students learn geometric ideas, connecting the two disciplines. It is also commonly known that descriptive geometry is significant in academia. Although descriptive geometry is important in engineering and architecture, it has seldom been used for instruction in Art education. Descriptive geometry improved students' spatial awareness and precision in creating artwork. (Martín Pastor & Vargas Peña, 2024). İbili et al. (2020) found that descriptive geometry lessons improved students' ability to visualize and form complex shapes, resulting in more complex art. Martinez's study also showed that descriptive geometry in art lessons boosted students' critical thinking and spatial relationships. These studies are advocating for a multidisciplinary approach, suggesting that university lecturers and students in Art Departments

should utilize digital tools like AutoCAD with descriptive geometry in pedagogical activities.

In recent years, digital technology has transformed several fields of education, including art education. Universities now incorporate digital tools such as AutoCAD into art and design education. Students acquire the skills of complex geometric drawing using AutoCAD, a powerful tool utilized in architecture, engineering, and design. Technology has been introduced in art education to align with current educational trends that aim to prepare students for a constantly changing digital environment by making them computer-savvy and literate. The visual representation of three-dimensional objects in descriptive geometry improves students' spatial relationships and geometric understanding. Using AutoCAD to include descriptive geometry in art classes may help students relate the visual arts to STEM subjects. This interdisciplinary approach helps students become technically adept and stimulates their creativity by letting them attempt many art forms. Students get a deeper understanding of the technical and artistic aspects of their work as they work with three-dimensional objects and sophisticated geometric patterns.

Problem statement

So far, the efforts to integrate cutting-edge digital technologies into artistic courses are still faced with a number of challenges. However, there are not many studies that have investigated the role of AutoCAD in enhancing creativity among students (Norboyo'gli, 2024)... This issue is even more pronounced in the geographic area covered by this study, underscoring the importance of this study. Access to hardware and software compatibility has remained an obstacle for both teachers and students, directly affecting their ability to overcome the steep curve of learning technology in art education. In order to grow into proficient artists, students need to practice with both digital and traditional art mediums. The purpose of this study is fourfold: to analyze the existing state of digital technology integration in art education, to identify leaders and laggards in this process, to evaluate relevant data and statistics, and finally, to propose solutions that could potentially accelerate and improve this process.

Objectives

The integration of AutoCAD with descriptive geometry holds significant potential to address numerous existing limitations, providing new avenues to

improve students' technical abilities and knowledge. The present study employs descriptive geometry analyses to evaluate essential elements of art education programs and find ways of utilizing AutoCAD to achieve this goal. By merging technological innovation with traditional art education, this research uncovers fresh, dynamic ways for students to explore and engage with the concepts of art. This study is guided by the following research questions:

- What can AutoCAD teach us about the use of descriptive geometry across the disciplines of art education?
- What are some benefits and drawbacks to adding AutoCAD to the art curriculum?
- How does AutoCAD affect students in terms of their spatial and creative thinking?

This research paper is very important, and it also aims to bring together traditional art education with modern technology. AutoCAD will be helpful to educators who intend to produce more engaging, hands-on lessons that resonate with a generation who are digital natives. This study also contributes to the broader discourse surrounding classroom technology by recommending more

research on how digital tools can be combined in various educational contexts.

This study is organized as follows: Section one reviews literature on art education, descriptive geometry, and the use of AutoCAD in teaching. Section two explains the research method, including procedures for data collection and analysis. Section three gives the theoretical underpinning and concepts of descriptive geometry. Section four presents findings of the study, and section five concludes the major findings of the study and explains its educational implications.

Literature review

The increased use of digital technologies in classrooms has significantly reshaped teaching methods across various disciplines. AutoCAD and other digital technologies have helped art students to express themselves artistically and develop their technical abilities. This literature study examines art education, descriptive geometry, and AutoCAD in the classroom to show how they might increase students' performance.

University projects have always encouraged art students' ingenuity, taste, and skill. Digital technologies have changed art education by providing new

ways to teach and engage students. Chiu (2021) reports that digital design software has considerably enhanced art class engagement and motivation. Digital tools that allow creative form, color, and composition exploration help teachers fulfill the requirements of students with different interests and learning styles. Qiu and Zhang (2023) examine how digital tools affect students' geometric art understanding, underlining its revolutionary potential. Their study reveals that 3D modeling software helps pupils perceive and engage with forms and explore spatial relationships.

Integration of mathematical concepts and artistic expression prepares students for future careers that need digital design skills. Descriptive geometry permits two-dimensional visual depiction of three-dimensional objects, making it essential to engineering and the arts. Descriptive geometry, developed in mechanical design and architecture, helps conceptualize complex forms and structures. It helps students study spatial logic and precision and is used for creative projects as well as technical teaching.

Artemenko et al. (2020) emphasize the use of descriptive geometry in art lessons for improving students' technical skills and spatial awareness. Flattening three-

dimensional objects into two-dimensional surfaces improves students' visual communication and problem-solving skills. Schoevers et al. (2022) add that descriptive geometry fosters classroom creativity. Martinez found that teaching descriptive geometry fosters creativity and introduces new ways. The precision and versatility of AutoCAD in creating technical drawings and three-dimensional models have long been associated with engineering and architecture. Combining mechanical aptitude with artistic ideas has sparked interest in incorporating it into art instruction. Nichols (2023) examined how AutoCAD influences students' creative development, saying that digital design tools help students conceptualize and produce detailed art. Students may experiment and iterate using AutoCAD's many innovative styles and methodologies.

Kaljun (2024) examines the broader effects of incorporating AutoCAD into instructional methods by emphasizing AutoCAD's role in developing 21st-century skills, including digital literacy, collaboration, and critical thinking. Their results show that training students to utilize digital tools like AutoCAD in the classroom makes them more employable and equips them for success in our digital

age. Working with AutoCAD helps students understand how art, technology, and innovation intersect and improve their technical skills. Previous studies reveal some critical ideas on incorporating descriptive geometry and AutoCAD into art education curricula. Research demonstrates that students are more interested and motivated when they may experiment and explore creatively using digital tools (Bereczki & Kárpáti, 2021). Second, descriptive geometry systematically teaches technical skills and spatial thinking, which are essential for creativity and any vocation (Ilić et al., 2020). Finally, AutoCAD allows students to create high-quality artworks and develop essential skills by combining technical correctness with creative flexibility (Cai, Zhang, & Xie, 2024). Even though great breakthroughs have been achieved, further research is needed to address gaps in the literature. Although existing studies suggest that utilizing AutoCAD and descriptive geometry in art courses may be advantageous, there is little research on how to teach these in diverse settings. More research is needed on how digital technology affects students' creativity and employability. Filling these gaps will advance the profession conceptually and provide instructors with ideas for using new

classroom practices to enhance art instruction.

Methodology

Research design

This study employed both quantitative and qualitative approaches to examine the use of descriptive geometry and AutoCAD in the university under study. Data collection was conducted simultaneously through questionnaires, in-person interviews, and observations. This research method is particularly and widely utilized among art students and instructors. To ensure relevant and informed perspectives, participants were purposefully selected from educators who had previously taught or were currently teaching AutoCAD and descriptive geometry within an art curriculum. In semi-structured interviews, art teachers discussed their integrated experiences and insights. These interviews covered teaching techniques, instructional strategies, the benefits of these methods for students, and the challenges of implementation. Participants granted permission for audio recordings of all interviews, which were then transcribed verbatim for analysis. The predetermined number of questions was approximately 15, with an additional 10 unforeseen follow-up questions.

Furthermore, interviews were conducted with art students who had participated in descriptive geometry and AutoCAD classes, and they were categorized into separate groups. During these sessions, students shared their perspectives, experiences, and emotions regarding these tools and their impact on their learning and creative development. Open-ended questions allowed participants to discuss the significance of digital technologies, their influence on technical skills and creativity, and the challenges they encountered. Documented evidence included lesson plans, students' artistic works, AutoCAD projects, and descriptive geometry materials. Additionally, a structured questionnaire comprising over 15 questions was distributed to participants. Informed consent was obtained, and confidentiality of the respondents was ensured before they responded to the questionnaire. The analysis of these documents provided deeper insights into the use of digital resources in the art curriculum, including assessment techniques, learning objectives, and curriculum design.

This study was conducted with the financial support and ethical oversight of the XXX university Ethics Committee. The committee supervised all stages of the research and granted the necessary

approvals. The official ethics approval document (Ref. No. 18) dated 01/09/2023, is provided in the appendix.

Research population

A total of 60 individuals from the university participated in the interviews, comprising 55 art students and 5 instructors. The students were bachelors between the ages of 20 and 24, all of whom had previously used AutoCAD and other digital technologies in their educational and learning activities. The instructors were between the ages of 35 and 50, each possessing over 10 years of teaching experience in art-related subjects at the university. All participants had prior experience in integrating digital technologies into classroom instruction.

Data analysis

Thematic analysis was utilized to uncover patterns, themes, and categories in qualitative data (Braun & Clarke, 2006). First, transcripts and articles were consulted to enhance the understanding of the data set. Afterwards, data were meticulously classified following the key themes and concepts pertinent to the research subjects to develop codes. After that, the codes were sorted into themes and subthemes that highlighted the

Integration of AutoCAD in art education

dataset's significant findings. Throughout this process, the themes of the study were continually validated and cross-referenced with the original sources to ensure their reliability and accuracy.. Participants' stories and examples helped explain how art education employs AutoCAD and descriptive geometry. Throughout the investigation, ethics were paramount. Informed consent was obtained before each interview or focus group session. Participants were kept anonymous and confidential during the research. The study technique followed institutional ethical norms and guidelines for human research, ensuring participant safety and ethical integrity.

Findings

This section presents data gathered from student focus groups, document analysis, and interviews with art teachers. The results are organized into four key themes: the role of AutoCAD in art education, its influence on students' technical and artistic abilities, the challenges encountered, and the perceived advantages and outcomes of the program. Qualitative findings are supplemented by tables and figures that provide supporting statistical data.

AutoCAD usage in art classrooms differs depending on the university and the

specific classroom. Art and design teachers often utilize AutoCAD for technical drawing and geometric design. A tutor said, "AutoCAD has become an essential tool for our design projects, allowing students to create precise and complex geometric patterns that they couldn't achieve by hand". According to the course materials and lesson schedules, students learned AutoCAD in phases, starting with basic tutorials and progressing to more complex projects. A focus group comprising students reported

mixed feelings about using AutoCAD in art class. Some welcomed the challenge of acquiring new skills, while others struggled to switch from analogue to digital creation. A student remarked, "It was hard at first to get used to the software, but once I got the hang of it, I could see how it made my designs more professional and detailed". Asking educators how frequently they used AutoCAD in their courses was helpful in measuring integration. Table 1 summarizes replies

Table 1: Educators' use of AutoCAD

Frequency of AutoCAD use	Educator's use of AutoCAD percentage
Daily	25%
Weekly	50%
Monthly	15%
Occasionally (less than monthly)	10%

The impact of AutoCAD and geometry on students' creativity and technical skills
AutoCAD and descriptive geometry improved students' technical skills and inventiveness. Many students felt AutoCAD improved their understanding of geometric ideas and three-dimensional

forms. A tutor said, "Students are developing a much stronger grasp of spatial relationships and precision, which is reflected in their artwork" (Zhamankaraev Sergazy, University Professor, October, 16 and 2024). In many ways, AutoCAD allowed students to

express themselves and increase their creativity. A kid stated, "Using AutoCAD has allowed me to experiment with more intricate designs and patterns that would be too time-consuming to draw by hand " (Tassybek Akmaral students educational programs 6B01416 – Art education, graphics and design , November, 13 and 2024). Others in class commented, "It's given me a new way to think about my

art, combining technical skills with creative ideas" (3rd year students of the educational program 6B01416 – Art education, graphics and design, November, 15 and 2024, Kazakhstan). Student artworks became increasingly complex and exact as the semester continued. We questioned students to see if AutoCAD boosted their ideas and technical skills. Table 2 shows the results

Table 2: Students' creativity and technical skills

Impact on creativity and technical skills	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Mean	Std. deviation	Cronbach's Alpha
Enhanced creativity	41.7%	43.3 %	10%	3.3%	1.7%	4.2	0.8	0.94
Improved technical skills	45%	35%	15%	3.3%	1.7%	4.1	0.9	
Better understanding of geometry	55%	30%	8.3%	6.7%	0%	4.3	0.8	

Challenges and barriers

Despite the benefits, AutoCAD is yet to become a standard in art education. Education experts say that both instructors and students find it difficult to understand the plan. "It took so much time and effort to be comfortable with AutoCAD, and some students did better than others," a tutor said. Software incompatibility and shortages of computer resources were also cited as obstacles. "There were software updates that were sometimes challenging, getting all the computers to be up to date, and so that sometimes halted lessons," a teacher said. Concerns were also raised about digital technology replacing traditional forms of art. Even some instructors worried that teaching digital skills may

phase out traditional drawing and painting. Lots of AutoCAD newbies complained about the first few hurdles, which have been on repeat. As one kid pointed out, "At first it was intimidating and made me nostalgic for how much I liked drawing with a pencil" [Kalel Yerkebulan, students educational programs 6B01416 – Art education, graphics and design , November, 14 and 2024]. Others wrote, "Not everyone has the same access to technology at home, which can make it difficult to keep up" (3rd year students of the educational program 6B01416 – Art education, graphics and design, November, 15 and 2024). Table 3 below shows the instructors' perspective of the barriers.

Table 3: Challenges and barriers from the educators' perspective

Challenges and barriers	Percentage of encountered challenges
Steep learning curve	60%
Technical issues (software/hardware)	45%
Limited access to technology at home	35%
Balancing traditional and digital methods	50%
Time constraints	40%

Perceived benefits and educational outcomes

The pilot AutoCAD and descriptive geometry courses in the art departments went successfully despite some challenges. Teachers familiar with AutoCAD found students' artwork was more precise and detailed. One of the most satisfying results is that students are able to produce professional-quality designs. The students also expressed how their skills would benefit them in their careers. "Knowing AutoCAD has given me a head start on pursuing a career in graphic design or architecture," one students said (Tursyn Yerkanat, students educational programs 6B01416 - Art education, graphics and design , November, 15 and 2024). A student said, "Sometimes it feels like we're learning these skills that's a gift – and we can use it outside of art class" during Romankul

Ramazan students educational programs 6B01416 - Art education, graphics and design, November, 16 and 2024. Finally, it was determined that students whose artworks were complex and intricately designed were those who successfully applied descriptive geometry. Table 4 shows the survey results on the education and perceived benefits. This indicates a positive perception among participants about the effectiveness of AutoCAD in improving job readiness, instilling greater design consideration in the students, and understanding interdisciplinary concepts, as indicated in the table below. Nonetheless, it also suggests that AutoCAD is better at promoting an interdisciplinary understanding and encouraging a multifaceted approach to art education, where artistic expression is aligned with technical skills.

Table 4: Perceived benefits by participants (students and teachers)

Perceived benefits and educational outcomes	Very high	High	Moderate	Low	Very low	Mean	Std. deviation	Cronbach's Alpha
---	-----------	------	----------	-----	----------	------	----------------	------------------

Improved attention to detail	36%	39.3%	19.7%	3.4%	1.6%	4.0	1	
Enhanced career readiness	49.2%	36%	14.8%	0%	0%	4.3	0.7	0.91
Greater understanding of interdisciplinary concepts	55.7%	29.5%	9.8%	5%	0%	4.3	0.8	

Discussion

This study indicates that AutoCAD and descriptive geometry may enhance art education. AutoCAD was gradually integrated into the curriculum, primarily for technical drawings and geometric design projects. As shown in Table 2, students expressed a positive perception of AutoCAD's capabilities and its potential to foster creativity and improve the creative process. It is evident that AutoCAD and other digital technologies have helped students develop technical and creative skills that will be valuable in the future. However, these innovations must be implemented carefully and with adequate support to address identified

challenges and limitations, ensuring that all students can benefit.

As indicated in Table 4, participants rated their understanding of AutoCAD's capabilities highly, particularly regarding its role in enhancing interdisciplinary comprehension. According to longitudinal research, these technologies may also influence students' creativity and job readiness over time. However, educators confirmed that they faced technical challenges. Among these, "steep learning curves" accounted for the most significant concern among teachers, whereas "limited access to technology at home" was the least reported challenge. Despite these obstacles, both educators and students praised AutoCAD for its

precision, attention to detail, and contribution to job readiness.

Additionally, the study observed that students' creativity was enhanced through imagination, creation, and experimentation with complex 3D objects.

This supports prior studies that indicated digital technology boosts creativity by introducing new channels of expression and inquiry (Alique & Linares, 2019). However, this study shows that considerable challenges and barriers were encountered. This study supports prior findings that instructors need additional support and training to use new technologies in their classrooms (Boonmoh et al., 2021). Technical problems such as software incompatibility and limited computer resources were the major difficulties encountered. This research confirms that digital technologies improve students' technical proficiency and career readiness. Students' creativity is boosted by using AutoCAD, which allows them to imagine, create, and play with complex 3D objects (Peñin et al., 2004). Students recognize the relevance of AutoCAD skills for their future careers, emphasizing the necessity to integrate digital technology

in the curriculum to meet the employers' demands.

Implications for art education

This research has several implications for art education. AutoCAD and descriptive geometry in art lessons may boost students' technical and artistic skills. They will gain valuable skills for their future careers. This suggests that art instructors should consider using digital tools to assist students learn and develop as artists. In the same way as AutoCAD, other digital technologies may be taught with simple lectures and more sophisticated projects. This strategy helps students gain confidence and skills while reducing discontent and disengagement. Teachers should consider delivering personalized instruction and help the pupils with varying technical comfort and competency. Finally, this research shows that instructors require additional resources and training to properly integrate digital technology into their teaching. Professional development initiatives that highlight digital literacy and software tools like AutoCAD may help educators gain confidence in using them. Software incompatibility and computer resource shortages must be addressed for digital technologies to benefit all pupils. Finally, the perceived benefits and educational outcomes of

AutoCAD highlight its importance in preparing students for the workforce. Integrating digital technologies into courses can enhance students' technical proficiency and job readiness, contributing to broader efforts to strengthen digital literacy and STEM competencies. Providing learning environments that promote digital skills will help students in the long term. The following educational concepts have been proposed by this study for art education:

Enhance teaching practices

Since descriptive geometry and AutoCAD are integrated into the university curriculum, teachers must adapt to this change and must understand these digital tools to help students succeed. Digital technology is dynamic, and AutoCAD encourages instructors to be interdisciplinary. Integrating art and STEM sectors may help teachers streamline learning. This improves the art curriculum. Thus, instructors should blend art and math to help pupils learn how imagination and skill work together. AutoCAD makes students more active learners. Teachers may spark students' imaginations by bringing geometric concepts into project-based learning. These tasks develop critical thinking, problem-solving, and learning responsibility in students.

Outcome of changes on student learning

One advantage of the use of AutoCAD and descriptive geometry in art classrooms is enhancing students' technical skills. Using AutoCAD, students can easily create complex geometric drawings which assist them in understanding spatial relationships and geometric concepts. Those skills are used in engineering, architecture and graphic design as well as art teaching. Students are encouraged to experiment by fusing traditional art with digital design. This new hybrid strategy allows students to use their creativity. Working with three-dimensional shapes allows for more nuanced and complex designs. Students have to use their ideas, geometry rules, and the advanced programs to get the results they want. This method allows students to reflect more critically and strategically, which is helpful in many school and career settings. Most students enroll in AutoCAD training to enhance creative and technical skills that are in demand in the job market. By studying this software programme, students may find themselves snatching a creative-tech job.

The data used for this study is up-to-date as of October 2023. Therefore, curriculum authors have to decide how to combine traditional creative methods with digital

activities and how to make the best use of digital resources. This balance is essential for imparting technical and artistic skills to children. To strike this balance, curriculum planners should bring AutoCAD into the curriculum iteratively. This approach to teaching software starts with simple courses and moves students toward more complex projects as they learn. This way, students are able to gain confidence and familiarity with the software, reducing the likelihood of frustration and disengagement.

Problems and potential solutions

Resolving these challenges requires a full integration of AutoCAD and descriptive geometry into the curriculum. Its steep learning curve makes mastering the software hard. When AutoCAD becomes difficult for students and instructors, it leads to frustration and disinterest. Educational institutions must properly invest in extensive teacher training and sustained support in order to solve this problem. Technical problems such as incompatible software or limited computer resources can also hold back learning. The second problem that needs to be solved is the optimal digital vs. traditional creative methods dichotomy. While AutoCAD has a lot of advantages, some students also need to do sketching

and painting. Instructors should design a guide that will accommodate both digital and traditional practice, as it will help college students become well-rounded.

Conclusion

Studies up to October 2023 have shown that digital tools can enhance students' ability to visualize spatial relationships in technical drawing and geometry, which are fundamental to both artistic and technical disciplines. Using AutoCAD, students can create more accurate and complicated designs that are frequently impossible with traditional techniques alone. Not only does this expand their artistic skill set, it also arms them with critical skills relevant to secure employment in a number of up-and-coming industries such as architecture, engineering, and digital media.

Moreover, integrating descriptive geometry into art lessons adds an interdisciplinary flavour, linking arts with STEM disciplines. This incites students to think critically and analytically, combining creative thinking with technical problem-solving skills. They excel at managing elaborate projects because they can mentally visualize and manipulate 3D objects in a 2D space.

While the benefits are stark, the study also tackles some challenges. Mastering

AutoCAD and descriptive geometry involves a steep learning curve that can discourage students and educators alike. It is also essential to have proper technological infrastructure – compatible software, adequate hardware – to effectively use these tools successfully. Transitioning from traditional art methods to digital platforms must be carefully managed to ensure students retain a strong foundation in core artistic principles. Since this shift requires steady engagement and support, it is essential that schools provide proper training for instructors so they can effectively guide students throughout this learning process. The combination of these technical and creative skills provides students with the tools they need to succeed in a rapidly evolving job market where digital competency is becoming increasingly important. These skills increase the employability value of students and, at the same time, foster a generation of innovators who could bridge the gap between technology and the arts.

Ultimately, bringing together AutoCAD and descriptive geometry into the art curriculum is the right step toward progressive art education now. Despite the obstacles ahead, the positive impact on students' technical skills, creativity,

and future job-market relevance must not be underestimated. In conclusion, by integrating technology into the school curriculum and making use of all these advancements to prepare our students for life beyond the classroom, education can become far more engaging than before and ultimately give students the tools they need to build their future.

Study's limitations

While the study offers interesting insights into how AutoCAD and descriptive geometry can be effectively utilized in the art departments of universities, there are, however, some shortcomings. In addition, because the sample size was small, the results may not be generalizable to other classes or curricular contexts. Future research should implement bigger and more heterogeneous samples to better comprehend the role of digital tools in art instruction. Second, interview and focus group data are self-reported and thus may be subject to bias and inaccuracy.

Various perspectives are analysed on triangulation, and further mean were used between all the data collected (theme analysis) to ensure credibility and validity. Classroom observations and student work evaluations were utilized to narrow down the already prescriptive

evaluation of how much digital technologies affect the flow of learning in art education. Third, the study noted that administrators, parents and lawmakers played a less important role than students and teachers. And when the new research and analysis on the benefits and challenges of digital, including digital tools in art education, emerges, future research will need to incorporate those perspectives of these parties as well.

Future research

Future research should address the challenges of integrating digital technology, particularly AutoCAD, into art education. This may include exploring new approaches to overcoming technical issues, comparing professional development programs for teachers, and ensuring equitable access to technology for all students. Longitudinal studies should examine how AutoCAD and other digital tools influence students' creativity and job readiness to determine their long-term benefits. Additionally, future research should explore the incorporation of digital design software into art curricula, assessing its impact on spatial reasoning and technical proficiency. Emerging technologies such as VR and AR could further enhance artistic expression and knowledge acquisition in AutoCAD-

based learning environments. Similarly, integrating art education with STEM disciplines through AutoCAD and computational design may better prepare students for modern careers by fostering coding skills and computational thinking.

Declarations

Competing Interest declaration: The authors declare that there are no competing interests. The authors have no relevant financial or non-financial interests to disclose.

Funding Declaration: This research is financed by the Abai Kazakh National Pedagogical University (contract №05-04/329 from 14.05.2024)

Competing interest declaration

The authors declare that there are no competing interests. The authors have no relevant financial or non-financial interests to disclose.

Acknowledgements

In accordance with the signed calendar plan for the implementation of scientific, scientific and technical projects on the basis of the Rector's grant within the framework of the Order No. 05-04/329 of 14.05.2024, Abai KazNPU was prepared according to the project «0124РКИ0249 - Interpretation of the Main Aspects of the School Visual Arts Curriculum

through the Lens of Descriptive Geometry
Analysis in the AutoCAD Environment».

ORCID

Aidar Kuzdeubayev: Orcid number: <https://orcid.org/0000-0003-4505-251X>

Karim Baigutov: Orcid number: <https://orcid.org/0000-0002-1013-5123>

Medetbek Abdirassilov: Orcid number: <https://orcid.org/0009-0005-2322-4255>

Azat Abdrassilov: Orcid number: <https://orcid.org/0000-0001-9741-4725>

Yerzhan Ryssymbetov: Orcid number: <https://orcid.org/0000-0003-4115-9387>

Sarsengali Bekeshov: Orcid number: <https://orcid.org/0000-0001-5476-0476>

References

Alique, D., & Linares, M. (2019). The importance of rapid and meaningful feedback on computer-aided graphic expression learning. *Education for Chemical Engineers, Volume 27, April 2019, Pages 54-60.* <https://doi.org/10.1016/j.ece.2019.03.001>

Artemenko, O., Artemenko, D., Martynenko, S., & Cherednychenko, N. (2020). Specific nature of spatial awareness formation of the Bachelor of Technical Higher Education Institution of Ukraine during the basic course. *Journal of Technical Education and Training, 12(2), 87-98.* <https://publisher.uthm.edu.my/ojs/index.php/JTET/article/view/5612> <https://doi.org/10.30880/jtet.2020.12.01.009>

Bereczki, E. O., & Kárpáti, A. (2021). Technology-enhanced creativity: A multiple case study of digital technology-integration expert teachers' beliefs and practices. *Thinking Skills and Creativity, Volume 39, March 2021, 100791.* <https://doi.org/10.1016/j.tsc.2021.100791>

Boonmoh, A., Jumpakate, T., & Karpklon, S. (2021). Teachers' perceptions and experience in using technology for the classroom. *Computer-Assisted Language Learning Electronic Journal, 22(1), 1-24.* <https://callej.org/index.php/journal/article/view/320>

Braun V., Clarke V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, Volume 3, 2006 – Issue 2, 77–101.
<https://www.tandfonline.com/doi/epdf/10.1191/1478088706qp063oa?needAccess=true>

Cai, Q., Zhang, X., & Xie, W. (2023). Art teaching innovation based on computer-aided design and deep learning model. *Computer-Aided Design & Applications*, 21(S14), 2024, 124–139. <https://doi.org/10.14733/cadaps.2024.S14.124-139>

Chiu, T. K. (2021). Digital support for student engagement in blended learning based on self-determination theory. *Computers in Human Behavior*. Volume 124, November 2021, 106909. <https://doi.org/10.1016/j.chb.2021.106909>

Cumino, C., Pavignano, M., Spreafico, M. L., & Zich, U. (2020). Geometry to build models, models to visualize geometry. *Digital Experiences in Mathematics Education*, 7, 149–166 (2021). <https://doi.org/10.1007/s40751-020-00080-6>

İbili, E., Çat, M., Resnyansky, D., Şahin, S., & Billinghurst, M. (2019). An assessment of geometry teaching supported with augmented reality teaching materials to enhance students' 3D geometry thinking skills. *International Journal of Mathematical Education in Science and Technology*, 51(2), 224–246.
<https://doi.org/10.1080/0020739X.2019.1583382>

Kaljun, K. K. (2024). Exploring the impact of video tutorials on AutoCAD learning: A comprehensive analysis of learning tasks, goals, and outcomes. 2024, 47th MIPRO ICT and Electronics Convention (MIPRO), Opatija, Croatia, 2024, pp. 445–450, <https://doi.org/10.1109/MIPRO60963.2024.10569436>

Ilić, M., Kosić-Jeremić, S., & Stavrić, M. (2020). Descriptive geometry and spatial ability-correlation and mutual impact at engineering students. *Tehnicki Vjesnik - Technical Gazette*, 27(6), 2001–2007. <https://doi.org/10.17559/TV-20190425181038>

Liu, X., Nagai, Y., Yabuuchi, K., & Cui, X. (2021). Use interactive media to enhance creativity of designers by stimulating the senses in the context of art design education. Proceedings of the Design Society , Volume 1: ICED21 , August 2021 , pp. 3319 – 3328 <https://doi.org/10.1017/pds.2021.593>

Martín-Pastor, A., & Vargas-Peña, R. (2024). Geometría descriptiva y pensamiento gráfico aumentado. *EGE-Expresión Gráfica En La Edificación*, 20, 4–21.
<https://doi.org/10.4995/ege.2024.20720>

Nichols, N. F. (2023). *A qualitative case study of high school art students' transfer of learning experiences between physical and digital tools*. PhD Dissertation, Northcentral University.
<https://www.proquest.com/openview/63aeabef79b6a2af12fefd4c3ac45baf/1?pq_origsite=gscholar&cbl=18750&diss=y>

Norboyo'gli, A. N. (2024). Development of creative abilities of students through engineering computer graphics (AutoCAD) in drawing science. *Ethiopian International Journal of Multidisciplinary Research*, 11(12), 66–69.
<https://www.eijmr.org/index.php/eijmr/article/view/2226>

Qiu, G., & Zhang, J. (2023). Application of digital technology in painting using new media and big data. *Soft Computing*, 27(17), 12691–12709.
<https://doi.org/10.1007/s00500-023-08852-z>

Schoevers, E. M., Kroesbergen, E. H., Moerbeek, M., & Leseman, P. P. M. (2021). The relation between creativity and students' performance on different types of geometrical problems in elementary education. *ZDM – Mathematics Education* (2022) 54:133–147. <https://doi.org/10.1007/s11858-021-01315-5>

Shiri, M., & Baigutov, K. (2024a). Exploring the influence of teachers' academic rank in advancing inclination to TPACK in art education. *Social Sciences & Humanities Open*, Volume 11, 2025, 101252. <https://doi.org/10.1016/j.ssaho.2024.101252>

Shiri, M., & Baigutov, K. (2024b). Evaluating art students' engagement with digital technologies in classroom settings. *International Journal of Advanced and Applied Sciences*, 11(11), 240–248. <https://doi.org/10.21833/ijaas.2024.11.025>

Zakaria, F., Ziden, A. A., & Othman, A. N. (2012). Effectiveness of AutoCAD 3D software as a learning support tool. *International Journal of Emerging Technologies in Learning (iJET)*, 7(2), pp. 57–60. <https://doi.org/10.3991/ijet.v7i2.1906>

Peñín, P. I. Á., Morales, M. R. P., García, D. R. R., Díaz, R. P. G., & Quirós, J. S. (2004). Multimedia-integrated application for computer-assisted teaching of technical drawing (AIMEC-DT). *Computer Applications in Engineering Education*, 12(2), 136–144. <https://doi.org/10.1002/cae.20003>