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Enhancing Students` Technical Competence in Sketching Using Sketchbook Application

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Abstract: Sketching is a fundamental skill in technical drafting, yet many students find traditional drawing methods challenging, time-consuming, and error-prone. The study examined the effectiveness of the Sketchbook application in improving the technical competence of Drafting and ICT students and their overall sketching performance. A quasi-experimental research design, specifically a single-group pretest-posttest approach, was utilized. The study involved 30 Grade 9 students who experienced challenges in technical competence in sketching. Their works were evaluated using a validated scoring rubric that was examined by the expert in the field. Based on the findings, the pre-test results showed a "Satisfactory" level of performance, indicating that students had basic sketching skills but still needed improvement. After the introduction of the Sketchbook application, the post-test results improved to an "Excellent" level, indicating a high level of competence in sketching. There was also a significant difference between the pre-test and post-test results, confirming an improvement in students' performance. The effect size analysis revealed a large effect, indicating that the Sketchbook application had a strong and meaningful impact on enhancing students' technical competence in sketching. Beyond improving their technical skills, it also fostered greater confidence and engagement in the learning process.

Keywords: Sketchbook Application, Digital Sketching, Technical Competence, Accuracy, Drafting, Efficiency

I. INTRODUCTION

Background of the Study

Portrait drawing is not only about creating a person's face but also about expressing emotions and personality. Many students today are more comfortable using technology, making digital tools such as the Sketchbook application helpful in making drawing activities easier, more engaging, and less intimidating. Instead of replacing traditional methods, these tools support learning by helping students practice more effectively and build confidence in their artistic skills.

However, many learners still face challenges in traditional sketching activities, especially in achieving proper proportions, shading, and line quality. These difficulties often lead to fear of making mistakes and reduced confidence in drawing. Digital applications help address these problems by providing a safe and guided environment where students can practice freely without worrying about wasting physical materials. Features such as layers, guides, and undo/redo functions allow students to explore and improve their sketching techniques with greater ease.

Research also shows that sketching is closely connected to spatial abilities, which are important in technical and vocational education. Students with stronger spatial skills are more likely to produce accurate and high-quality sketches. Digital drawing applications also help learners improve shading, line work, and overall sketch quality, especially for beginners. As a result, these tools not only enhance technical competence but also increase students' engagement and interest in sketching activities.

In this study, the Sketchbook application was used as an intervention to strengthen students' technical competence in sketching regardless of their skill level or prior experience. The application provided students with opportunities to practice in a flexible, interactive, and technology-driven environment. Through the use of digital tools and features, students were able to develop their creativity, confidence, and sketching abilities. The study highlights the importance of integrating technology into education to improve learning experiences and prepare students for modern, technology-based classrooms.

Objectives of the Study

This study aimed to determine the efficiency of the Sketchbook Application in making portrait drawing among Junior High School Grade 9 students at East Villaflores
National High School, Maayon, Capiz. Specifically, it sought to answer the following objectives:

1.Determine the performance of Grade 9 students in making portrait drawings before using the Sketchbook application.

2.Determine the performance of Grade 9 students in making portrait drawings after using the Sketchbook application.

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3.Determine if there is a significant difference in the performance of Grade 9 students in making portrait drawings before and after using the Sketchbook application.

4.Determine the effect size of the Sketchbook application on the performance of Grade 9 students.

II. METHODOLOGY

Research Design

This study focused on determining the effect of the Sketchbook application on the technical competence of Grade 9 students in Drafting and ICT subjects. To measure its effectiveness, the researcher used a quasi-experimental research design, particularly a single-group pretest-posttest design, where the same group of students was evaluated before and after using the application. This approach allowed the researcher to observe changes in students' sketching skills and technical competence without the use of a control group or random assignment. Through the pretest and posttest results, the study was able to determine how the Sketchbook application helped improve students' performance. The findings also showed that digital sketching tools can be valuable in supporting instruction, enhancing learning experiences, and developing students' skills in sketching.

Locale and Respondents of the Study

The study was carried out at Brgy. Villaflores National High School. For the academic year 2025–2026, East Villaflores, Maayon, Capiz. The thirty Grade 9 Drafting and ICT Major students from East Villaflores National High School in Brgy. participated in the study. During the academic year 2025–2026, students in the Drafting and ICT course in East Villaflores, Maayon, Capiz, actively participated in sketching and portrait drawing exercises.

Research Instrument

A scoring rubric was employed as the research tool to evaluate sketching and portrait drawing outcomes. The panel and advisory members validated the rubric. The comments and recommendations for improving and updating the rubrics were combined, added, and submitted for approval. Data for the study was gathered using the finished rubric following the instrument's validation and approval. Accuracy, line quality, value or shading, neatness, and speed were the five categories on the scoring rubric. Accuracy (5 points) assessed how well the students' copy sketches made using the Sketchbook app resembled each other, especially in terms of accurate facial dimensions and feature arrangement. Additionally, it assessed how well students used the fundamentals of sketching in their digital illustrations. Line Quality (5 points) evaluated the sketch's control, uniformity, and clarity of the lines employed to determine whether the strokes are confident, neat, and applied correctly. Value of Shading (5 points) assessed how well the students were able to use the proper shading techniques to give the portrait drawing depth and shape. Neatness (5 points) evaluated the sketch's general order and cleanliness by looking for extraneous lines, double strokes, and clutter in the digital workspace. Finally, Speed (5 points) assessed if the sketch was finished and sent in on time. Together, these factors demonstrated how the Sketchbook program improved students' technical proficiency in drawing portraits.

After the instrument had been validated and approved, the finalized rubrics were utilized for data gathering. The researcher then carried out a face-to-face evaluation of the students' outputs using the scoring rubrics. A 25-point evaluation rubric was used in the study to measure the students' sketching performance both before and after the introduction of the Sketchbook application. The scores were then interpreted according to levels of technical competence, where 20.21–25.00 was considered excellent, 15.41–20.20 very satisfactory, 10.61–15.40 satisfactory, 5.81–10.60 needing improvement, and 1.00–5.80 poor performance.

Data Gathering Procedure

The study was conducted in three phases. Phase 1 involved identifying the participants, specifically the Grade 9 Drafting and ICT students of East Villaflores National School for the School Year 2025–2026, and developing a validated scoring rubric to assess students' technical competence in sketching. Expert validation was conducted, and revisions were made until the final rubric was completed.

Phase 2, known as the Experimental Phase, started with a pre-test to determine the students' initial sketching competence. Students completed a sketching activity, and their outputs were evaluated using the validated rubric. Afterward, students participated in structured instructional sessions using the Sketchbook application, which included demonstrations, guided practice, and hands-on activities. The pre-test results were analyzed using SPSS to determine students' baseline performance.

Phase 3, or the Post-Experimental Phase, involved administering a post-test after the intervention sessions. Students created portrait sketches using the Sketchbook application, and their outputs were assessed using the same rubric. The pre-test and post-test results were then compared and analyzed through SPSS to determine the effectiveness of the Sketchbook application in improving students' technical competence in sketching.

Intervention

To conduct the study, the researcher first gave a pre-test to assess the students' initial skills in sketching and portrait drawing before introducing the Sketchbook application. The participants were 30 Grade 9 Drafting and ICT students from East Villaflores National High School. During the intervention, students were introduced to the application

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and joined face-to-face sessions that included demonstrations, guided practice, and hands-on activities. They explored different tools in the Sketchbook application, such as brushes, layers, and shading features, while creating sketches and portrait drawings. The use of technology made the lessons more interactive and engaging for the students. At the end of the study, students created portrait sketches that showed their improvement in technical competence, creativity, and digital sketching skills.

Data Analysis Procedure

Descriptive and inferential statistical tools were applied to determine the effectiveness of the Sketchbook application on students' technical competence in sketching. The mean was used to measure the students' level of performance and determine the extent of improvement between the pretest and post-test scores. Meanwhile, the paired t-test was employed to identify whether there was a significant difference between the students' performance before and after the intervention. Since the same group of participants took both tests, the paired t-test was appropriate for comparing the related scores. A two-tailed test with a 0.05 level of significance was used in testing the hypothesis. In addition, Cohen's d was utilized to measure the effect size of the intervention and determine whether the improvement in students' performance was small, moderate, or large in practical significance. All statistical analyses were processed using SPSS software.

III. RESULTS AND DISCUSSION

Performance of Grade 9 Students in Portrait Drawing before using the Sketchbook Application

The table 1 results showed that the participants obtained a mean score of 15.39 before using the Sketchbook application, which was verbally interpreted as "Satisfactory." This indicates that students had acceptable but still limited skills in portrait drawing, particularly in areas such as proportion, shading, line quality, and overall presentation. Although students were able to perform basic sketching tasks, their outputs still lacked refinement and consistency, showing that their technical competence still needed improvement. The standard deviation of 1.75 further reflected that students generally possessed only satisfactory skills before the intervention.

Performance of Grade 9 Students in Portrait Drawing after Using the Sketchbook Application

The table 2 results showed that after using the Sketchbook application, the participants obtained a mean score of 20.66, which was verbally interpreted as "Excellent." This indicates that the students demonstrated a high level of performance in creating portrait drawings after the intervention. The standard deviation of 0.79 showed that the students' scores were closely grouped around the mean, suggesting consistent performance and minimal variation among participants. This implies that most students benefited from the Sketchbook application regardless of their initial skill level.

Difference in the performance of Grade 9 Students In Portrait Drawing before and after Using the Sketchbook Application

Table 3 shows a significant difference in the performance of Grade 9 students in portrait drawing before and after using the Sketchbook application. The students' mean score increased from 15.39, verbally interpreted as "Satisfactory" in the pre-test, to 20.67, interpreted as "Excellent" in the post-test, with a mean difference of 5.28. This improvement indicates that the students' technical competence in portrait drawing significantly developed after the intervention. The computed p-value of 0.000, which is lower than the 0.05 level of significance, led to the rejection of the null hypothesis, confirming that the improvement in students' performance was significantly influenced by the use of the Sketchbook application and not by chance.

Effect Size of Sketchbook Application on the Performance in Portrait Drawing of Grade 9 students

Table 4 presents the effect size of the Sketchbook application on the performance of Grade 9 students in portrait drawing. The results showed a mean difference of 5.28 with a standard deviation of 1.79, resulting in a Cohen's d value of 2.96, which was interpreted as a "Large Effect." This indicates that the improvement in students' performance after the intervention was not only statistically significant but also highly meaningful in practical terms. The large effect size suggests that the Sketchbook application had a strong impact on improving students' technical competence in portrait drawing, particularly in areas such as proportion, line quality, shading, and overall composition. The findings imply that the application effectively addressed students' difficulties with traditional sketching methods and provided substantial improvement in their drawing performance.

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IV. CONCLUSIONS

The following conclusions were drawn based on the summary of findings of the results in the study. The students' initial performance demonstrates foundational abilities but lacks refinement, which justifies the integration of digital applications such as Sketchbook. Such tools provide structured guidance and opportunities for practice, enabling learners to enhance their technical competence and achieve greater proficiency in portrait drawing. The findings establish that technology-based interventions, such as the Sketchbook application, can substantially elevate students' artistic competence. The study, therefore, confirms the effectiveness of digital sketching tools in fostering skill development and highlights their practical value in advancing visual arts education. The findings conclude that the Sketchbook application provided meaningful instructional support, enabling students to overcome challenges associated with traditional sketching methods. The significant improvement from "Satisfactory" to "Excellent" underscores the strong educational impact of integrating digital tools into art instruction, validating their effectiveness in developing technical competence in portrait drawing.

Integrating technology-based tools such as the Sketchbook application into classroom instruction can substantially enhance learners' artistic performance. This underscores the practical value of digital interventions in fostering skill development, creativity, and confidence, thereby contributing to more effective and significant gains in accuracy, proportion, shading, and line quality. This highlights the transformative role of digital applications in art education. Therefore, the study concludes that the Sketchbook application is effective in improving students' portrait drawing skills. The large effect size further confirms that the improvement is substantial and meaningful, indicating that the application significantly enhanced students' technical competence in sketching**.**

V. RECOMMENDATION

The study's findings suggest several avenues for improvement. Students are encouraged to actively explore the Sketchbook application, making use of its interactive features and practice exercises to strengthen their skills in portrait drawing and sketching. When they encounter challenges, they are advised to seek assistance from their teachers or collaborate with classmates to enhance understanding and overcome difficulties. For teachers, integrating the Sketchbook application into drawing instruction has been found to improve students' competence and engagement. It can be used for guided practice as a supplementary learning tool. However, before implementing it, teachers need to familiarize themselves with the application's functionalities and provide proper guidance on how to navigate and utilized it effectively.

Students are encouraged to practice regularly with digital drawing tools, such as the sketchbook app, to further develop their sketching skills. Through consistent practice, they will be able to improve their control in lines, shading techniques, proportions, and overall composition. Additionally, digital tools allow students to easily edit and refine their work, helping them learn from their mistakes and gradually build confidence and creativity in producing high-quality drawings. School administrators play an important role in the successful integration of digital tools in education. They may provide the necessary resources, such as a drawing tablet, a stable internet connection, and access to digital applications. Moreover, training programs and workshops may be conducted for both teachers and students to equip them with the knowledge and skills needed to effectively use digital drawing tools in the teaching and learning process.

Finally, future studies may be conducted to investigate the long-term impact of using digital drawing tools on students' artistic growth and skill retention. This includes examining whether the improvements in drawing skills are sustained over time and how continuous exposure to digital tools influences students' creativity, motivation, and artistic style. Such studies are expected to provide deeper insights into the lasting benefits of integrating technology in art education.

VI. REFERENCES

[1]. Ahmed, S., & Rahman, T. (2025). Digital sketching applications and student creativity in secondary education. *International Journal of Educational Technology, 30*(1), 55– 70.Aldunate, R., & Nussbaum, M. (2018). Teacher adoption of technology in primary schools. *Computers & Education, 100*, 51–62.

[2]. Alvarez, M., & Kim, J. (2021). Student motivation and engagement in digital art learning environments. *Journal of Art Education and Technology, 15*(2), 88–102.

[3]. Akkuş, İ., & Arslan, P. Y. (2022). The effects of augmented reality in the technical drawing course on engineering students' spatial ability and academic achievement. *Journal of Learning and Teaching in Digital Age, 7*(2), 160–174.

[4]. Almerich, G., Orellana, N., Suárez-Rodríguez, J., & Díaz-García, I. (2016). Teachers' information and communication technology competences: A structural approach. *Computers & Education, 100*, 110–125.

[5]. Astra, I. M., Nasbey, H., & Nugraha, A. (2015). Development of an Android application in the form of a simulation lab as learning media for senior high school students.

DOI: 10.17148/IARJSET.2026.13598

https://www.ejmste.com/download/development-of-an-android-application-inthe- form-of-a-simulation-lab-as-learning-media-for-senior-4424.pdf

[6]. Aydin, S., & Özçelik, M. A. (2014). The effects of mobile learning environments on students' technical drawing skills. *Educational Technology & Society*, *17*(2), 112– 124.

[7]. Autodesk. (2019). *SketchBook user guide*.

[8]. Bairaktarova, D., Van Den Einde, L., & Bell, J. (2019, June). Using Digital Sketching and Augmented Reality Mobile Apps to Improve Spatial Visualization in a Freshmen Engineering Course. Paper presented at the 2019 ASEE Annual Conference & Exposition, Tampa, FL. [Award ID(s) 1831294, NSF-PAR ID 10221680].calvine-odero-swmuf.

[9]. Becerra, L. A., Hill, E. M., & Abraham, K. M. (2022). Self-portraits and free drawings to reduce anxiety. *Art Therapy*, *39*(1), 34–42. https://doi.org/10.1080/07421656.2021.1976024

[10]. Booth, R., Cross, N., & Christiaans, H. (2016). Teaching sketching skills for novice designers. *Design Studies*, *43*, 1–23. https://doi.org/10.1016/j.destud.2015.11.002

[11]. Binbin Hu, & Ya Li. (2025). The role of digital drawing software in enhancing specific artistic skills and behavioral intentions in art education. *Cogent Education, 12*(1).

[12]. https://doi.org/10.1080/2331186X.2025.2481679

[13]. Christine Liao, Jennifer L. Motter, & Ryan M. Patton. (2016). Tech-savvy girls: Learning 21st-century skills through STEAM digital artmaking. *Art Education*.

[14]. Canadian Centre for Occupational Health and Safety. (2024). *Competency and workplace skills*. https://www.ccohs.ca

[15]. Dela Cruz, J., & Ramos, A. (2021). Digital art applications and student engagement in secondary education. *Philippine Journal of Educational Technology*, *13*(2), 45–58.

[16]. Delson, N., & Van Den Einde, L. (2018). Sketching, assessment, and persistence in spatial visualization training. *ASEE Conference Proceedings*. https://doi.org/10.18260/1- 2--30968

[17]. Dwyer, D. C. (2019). Development of a spatial visualization assessment tool. *ASEE Conference Proceedings*. https://doi.org/10.18260/1-2--34452

[18]. Camba, J. D., Kimbrough, S. O., & Kwon, S. (2018). Conceptual product design in digital and traditional sketching environments: A comparative exploratory study. *Design Studies, 54*, 1–22. https://doi.org/10.1016/j.destud.2017.10.003

[19]. Chen, Y., & Liu, S. (2024). Digital art learning environments and their impact on student drawing performance. *Journal of Visual Arts Education*, *19*(2), 45–60.

[20]. Chen, C. H., & Tsai, C. C. (2015). Interactive digital drawing tools in visual arts education. *Journal of Educational Technology*, 12(3), 45–56.

[21]. Carnevale, (2015). Freehand sketching and design process understanding.

[22]. da Silva, & Agostinho. (2018). Technology-supported learning approaches in education.

[23]. Dafiotis, D., Sylaiou, S., Stylianidis, E., Koukopoulos, Z., & Fidas, C. (2025). Evaluating uses of XR in fostering art students' learning. *Multimodal Technologies and Interaction, 9*(4), 36. https://doi.org/10.3390/mti9040036

[24]. Evans, M., & Aldoy, N. (2016). *Exploring digital sketching in design education: Enhancing creativity and communication.* Design and Technology Education: An International Journal, 21(2), 34–45.

[25]. Ertmer, P. A., Ottenbreit-Leftwich, A. T., & Tondeur, J. (2014). Teachers' beliefs and uses of technology to support 21st-century teaching and learning. In *International handbook of research on teachers' beliefs* (pp. 403–418). Routledge.

[26]. Francisco, F. M., & Navarro Lizandra, J. L. (2018). Enhancing freehand sketching in industrial design. *International Journal of Design Education, 13*(1), 37–58. https://doi.org/10.18848/2325-128X/CGP/v13i01/37-58

[27]. Garcia, M. (2022). Effects of computer-based drawing tools on students' artistic performance. *Journal of Philippine Arts and Design Education*, *8*(1), 23–37.

[28]. García, L., López, R., & Ramos, P. (2023). Enhancing visual-spatial skills through digital drawing tools. *Computers & Education*, *185*, 104512.

[29]. Gallardo-Echenique, E. E., de Oliveira, J. M., Marqués-Molias, L., Esteve-Mon, F., Wang, Y., & Baker, R. (2015). Digital competence in the knowledge society. *MERLOT Journal of Online Learning and Teaching, 11*(1).

[30]. Gao, W., Zhang, Y., Ramanujan, D., Ramani, K., Chen, Y., Williams, C. B., & Zavattieri, P. D. (2015). The status, challenges, and future of additive manufacturing in engineering. *Computer-Aided Design*, *69*, 65–89.

[31]. Ghavifekr, S., Kunjappan, T., Ramasamy, L., & Anthony, A. (2016). Teaching and learning with ICT tools: Issues and challenges from teachers' perceptions. *MOJET, 4*, 38–57.

DOI: 10.17148/IARJSET.2026.13598

[32]. Giampiero, D., Galiè, G., & Leonardo, F. (2025). Rethinking sketching: Integrating hand drawings, digital tools, and AI in modern design. *Designs, 9*(5), 119. https://doi.org/10.3390/designs9050119

[33]. Heskett, J. (2017). *Design: A very short introduction*. Oxford University Press.

[34]. Hsu, Y. C., & Ching, Y. H. (2017). Mobile applications for art and design learning. *Educational Technology & Society, 20*(3), 120–132.

[35]. Hu, B., & Li, Y. (2025). The role of digital drawing software in enhancing artistic skills. *Cogent Education, 12*(1). https://doi.org/10.1080/2331186X.2025.2481679

[36]. Harper, D. (2019). Online Etymology Dictionary – Sketch. https://www.etymonline.com

[37]. Hernández-Guacheco, M. A., & Reyes-Sánchez, F. (2016). Spatial ability and isometric drawing: A mediation analysis. *International Journal of Technology and Engineering Education, 12*(3), 237–248.

[38]. Hu, B., & Li, Y. (2025). The role of digital drawing software in enhancing specific artistic skills and behavioral intentions in art education. *Cogent Education, 12*(1). https://doi.org/10.1080/2331186X.2025.2481679

[39]. Hu, Y., Guo, X., Zhao, B., Lin, S., & Luo, X. (2014). 3D model editing from contour drawings on orthographic projection views. *Lecture Notes in Computer Science*, 612–619. https://doi.org/10.1007/978-3-319-07998-1_70

[40]. Ilomäki, L., Paavola, S., Lakkala, M., & Kantosalo, A. (2016). Digital competence—An emergent boundary concept for policy and educational research. *Education and Information Technologies, 21*, 655–679.

[41]. Kanivets, O. V., Kanivets, I. M., Kononets, N. V., Gorda, T. M., & Shmeltser, E. O. (2020). Development of mobile applications of augmented reality for projects with projection drawings.

[42]. Kaygorodtseva, N., & Luzgina, V. (2019). Practical skills in AutoCAD through a mass open online course. In *ICGG 2018 Proceedings* (pp. 1603–1610). Springer.

[43]. Kim, J., & Park, H. (2022). Effects of guided portrait drawing instruction on visual perception skills. *International Journal of Art & Design Education, 41*(3), 210– 225.

[44]. Koehler, M. J., & Mishra, P. (Eds.). (2016). *Handbook of technological pedagogical content knowledge (TPACK) for educators*. Routledge.

[45]. Lester, P. M. (2015). *Visual communication: Images with messages* (6th ed.). Wadsworth.

[46]. Lauer, D. A., & Pentak, S. (2018). *Design basics* (9th ed.). Cengage Learning.

[47]. Li, X., & Zhang, Y. (2021). Improving beginners' portrait drawing skills through structured practice. *Arts Education Research Journal, 12*(1), 33–48.

[48]. Liu, Y., & Chu, H. (2019). Digital platforms and students' artistic skill development. *Journal of Visual Arts Education*, 10(2), 33–45.

[49]. Leblanc, (2015). Sketchbooks as artistic and educational tools.

[50]. Lauer, D. A., & Pentak, S. (2018). *Design basics* (9th ed.). Cengage Learning.

[51]. Liao, C., Motter, J. L., & Patton, R. M. (2016). Tech-savvy girls: Learning 21st-century skills through STEAM digital artmaking. *Art Education*.

[52]. Lopez, R. (2024). Mobile learning applications in Technology and Livelihood Education. *Asia Pacific Journal of Education and Technology, 10*(1), 60–72.

[53]. Marquez, J. A. (2021). Mobile sketching applications as tools for enhancing students' basic drawing skills. *Philippine Journal of Arts and Technology Education, 5*(2), 45–56.

[54]. Martín-Mariscal, A., Fernández Rodríguez, J. F., María, A. A., & Peralta, M. E. (2025). Integrated creative design process: The role of sketching in industrial design. *International Journal of Designed Objects, 19*(1), 135–155.

[55]. Mohebi, S. (2021). Technology integration and student engagement in learning environments. *Journal of Educational Technology Research*.

[56]. Murphy, A., Farley, H., Lane, M., Hafeez-Baig, A., & Carter, B. (2014). Mobile learning anytime, anywhere: What are our students doing? *Australasian Journal of Information Systems, 18*(3).

[57]. Narciso, (2023).Enhancing student competence in technical drawing using ISOTOP application.

[58]. Panagiotis, D., Stella, S., Efstratios, S., Dimitrios, K., & Christos, F. (2025). Evaluating uses of XR in fostering art students' learning. *Multimodal Technologies and Interaction, 9*(4), 36. https://doi.org/10.3390/mti9040036

[59]. Paricio, J. (2015). *Perspective sketching: Freehand and digital drawing techniques for artists and designers*. Quarto Publishing Group.

[60]. Parakkat, A., Kumar, R., & Nair, S. (2020). Digital sketching tools and their impact on student learning engagement and technical skill development. *Education and Information Technologies, 25*(6), 5123–5138. https://doi.org/10.1007/s10639-020- 10234-7

[61]. Piaget, J. (2017). *The child's conception of physical causality*. Routledge.

[62]. Reyes, P., & Santos, L. (2023). Learner-centered approaches in digital art education. *Philippine Journal of Curriculum and Instruction, 17*(3), 88–101.

DOI: 10.17148/IARJSET.2026.13598

[63]. Ranscombe, C., & Bissett-Johnson, K. (2017). Digital sketch modelling: Integrating digital sketching as a transition between sketching and CAD in industrial design education. *Design and Technology Education, 22*(1), 1–15.

[64]. Rodriguez, M., Santos, L., & Cruz, A. (2023). Art therapy and emotional expression through portrait drawing among students. *Creativity and Education Studies, 8*(4), 101–115.

[65]. Rogers, P. J. (2014). Theory of change. In M. M. Mark, S. I. Donaldson, & B. Campbell (Eds.), *Social psychology and evaluation* (pp. 51–69). Guilford Press.

[66]. Sahin, I. (2015). Instructional technology and performance measurement in education. *Journal of Educational Technology, 12*(3), 45–56.

[67]. Salas-Rueda, R.-A., Eslava-Cervantes, A.-L., & Prieto-Larios, E. (2021). Analysis of the impact of flipped classroom and technology in the educational process on the design of graphic communication. *Vivat Academia, 154*, 25–39. https://doi.org/10.15178/va.2021.154.e1238

[68]. Santos, J., & Villanueva, M. (2020). Technology-assisted learning in visual arts education. *Mindanao Journal of Educational Research, 5*(2), 14–28.

[69]. Santos, R., & Lee, D. (2020). Tablet-based sketching as a tool for enhancing precision in technical drawing education. *Journal of Engineering Education Research, 15*(2), 45–58.

[70]. Siemens, G., Gašević, D., & Dawson, S. (2015). *Preparing for the digital university: A review of distance, blended, and online learning*.

[71]. Simmons, S. (2019). Drawing in the digital age: Observations and implications for education. *Arts Journal*. SketchBook. (n.d.). *SketchBook – Apps on Google Play*. https://play.google.com/store/apps/details?id=com.adsk.sketchbook

[72]. Suh, H., & Lee, J. (2022). Effects of mobile sketching applications on students' drawing performance. *Journal of Visual Arts Practice, 21*(3), 210–225.

[73]. Sánchez, R., & García, M. (2021). Gamification in digital sketching tools and student motivation. *Educational Media International, 58*(2), 101–115.

[74]. Santos, R., & Lee, D. (2020). Tablet-based sketching in technical drawing education. *Journal of Engineering Education Research, 15*(2), 45–58.

[75]. Salas-Rueda, R.-A., Eslava-Cervantes, A.-L., & Prieto-Larios, E. (2021). Flipped classroom and digital tools in graphic communication. *Vivat Academia, 154*, 25–39. https://doi.org/10.15178/va.2021.154.e1238

[76]. Sahin, I. (2015). Instructional technology and performance measurement in education. *Journal of Educational Technology, 12*(3), 45–56.

[77]. Spencer, L. M. (2017). Competency at work: Models for superior performance. Wiley.

[78]. Van Den Einde, L., Delson, N., & Cowan, E. (2019). Mobile sketching application for teaching spatial visualization. *ASEE Annual Conference & Exposition*.

[79]. Vygotsky, L. (2018). *La psicología en la Revolución Rusa*. Ediciones desde abajo.

[80]. Wang, F., & Hannafin, M. J. (2016). Design-based learning in digital environments. *Educational Technology Research and Development, 64*, 345–367.

[81]. Wong, W. (2019). *Principles of form and design*. Wiley.

[82]. Wong, K., Lim, S., & Tan, M. (2024). Stylus-based digital sketching and technical drawing accuracy in education. *Design and Technology Education Journal, 29*(1), 34–49.

[83]. Zhang, W., & Ranscombe, C. (2021). Embracing new visualisation tools in education: How digital sketching influences design practice. Cambridge University Press. https://doi.org/10.1017/pds.2021.135