



Educational Technology Integration in Watercolor Art Education: Evidence from Junior High Schools in Shijiazhuang, China

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Abstract: This study aims to examine the integration of educational technology into watercolor painting instruction and identify the factors associated with its effectiveness among junior high school students in Shijiazhuang City, China. An explanatory sequential mixed-methods design was employed. Quantitative data were collected from 360 students, 12 art teachers, and 6 teaching administrators across six schools through questionnaires, pretests, posttests, and learning assessments. The student sample comprised 180 students in the experimental group and 180 students in the control group, with each school contributing three experimental classes and three control classes. Qualitative data were collected through interviews, classroom observations, and document analysis. Quantitative data were analyzed using descriptive statistics, t-tests, ANOVA, correlation analysis, and regression analysis, while qualitative data were analyzed using grounded theory coding. The findings revealed no significant difference in pretest scores between the experimental and control groups. After one semester of intervention, the experimental group demonstrated significantly higher levels of watercolor skills, learning interest, and core competencies, including aesthetic judgment, creative thinking, and collaboration ($p < .001$). Regression analysis indicated that teachers' educational technology competence, interactive instructional design, and digital learning resources jointly explained 63.2% of the variance in learning outcomes. Qualitative findings further indicated that immersive technologies, digital painting tools, and online collaboration enhanced student engagement, creativity, and classroom interaction, despite challenges related to teacher workload and technical support. The findings suggest that the integrated teaching model is a feasible approach to strengthening watercolor education at the junior high school level and provide practical guidance for the systematic integration of educational technology into art education.

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Introduction

Art education has become an essential component of junior high school education because it cultivates students' creativity, aesthetic appreciation, imagination, and cultural awareness. Beyond developing artistic skills, art education encourages students to communicate ideas, solve problems creatively, and appreciate cultural diversity. With the rapid advancement of digital technologies, the objectives of art education have expanded to include digital literacy, collaboration, and innovation. Consequently, schools are expected to integrate educational technology into art instruction to create more engaging, interactive, and student-centered learning environments (UNESCO, 2023)

Educational technology has significantly transformed teaching and learning across various disciplines, including visual arts. Digital media, online learning platforms, virtual galleries, multimedia resources, and interactive applications enable teachers to provide richer



learning experiences than conventional classroom instruction alone (Harris et al., 2009). According to (Zhao & Frank, 2003), technology adoption in schools is influenced by ecological factors involving teachers, institutions, and learning environments. The theory of connectivism that learning in the digital era occurs through networks of information and collaboration, making technology an indispensable component of modern education (Redecker, 2017). Therefore, integrating educational technology into junior high school art education is no longer an option but a necessity.

Watercolor painting remains one of the fundamental learning activities in junior high school visual arts because it develops students' observation skills, creativity, color perception, and emotional expression (Eisner, 2022). Traditional watercolor instruction provides valuable hands-on experiences that cannot be completely replaced by digital technologies. Nevertheless, integrating digital technology into watercolor instruction offers opportunities to enrich students' learning experiences through multimedia demonstrations, digital portfolios, virtual exhibitions, and collaborative online learning activities (United Nations, 2023). Such integration enables students to combine conventional artistic techniques with contemporary digital competencies, preparing them for the demands of the twenty-first century (Mayer, 2021).

Recent studies indicate that educational technology positively influences students' engagement and learning outcomes in art education. Virtual reality technology enhances students' appreciation of artworks and increases learning motivation. Similarly (Bond, 2020). Digital painting software improves students' artistic exploration and creative performance in secondary schools (Koehler et al., 2013). Furthermore, online collaborative platforms strengthen students' cooperative learning abilities (Trust, 2018). Emphasized that teachers' professional competence in educational technology integration is a critical factor determining successful technology-enhanced art instruction (Koehler et al., 2013).

Despite these developments, the implementation of educational technology in junior high school art education remains inconsistent. Many schools continue to rely primarily on conventional teaching methods due to inadequate technological infrastructure, limited teacher competence, and insufficient digital learning resources (Mishra & Koehler, 2006). In many classrooms, technology is used only as a presentation tool rather than as an integral component of creative learning activities. Consequently, students have limited opportunities to experience innovative learning environments that effectively combine traditional artistic practices with digital technologies. This study aligns with domestic and international findings on how educational technology enhances art teaching effectiveness while directly addressing key limitations in previous research. Specifically, it develops targeted, practical teaching models tailored to junior high school watercolor instruction and grounds them in the Shijiazhuang region by incorporating local cultural elements to boost real-world applicability. Furthermore, the study utilizes a mixed-method research approach to establish a comprehensive evaluation system centered on core student competencies.

This study aims to explore innovative pathways and models for integrating watercolor art instruction with educational technology in junior high schools in Shijiazhuang City, validate the application efficacy of this blended teaching approach, and provide practical references and theoretical support for enhancing watercolor art education quality and promoting students' core competency development.



Research Method

This study employed an explanatory sequential mixed-methods design, in which quantitative data were collected and analyzed in the first phase, followed by qualitative data to explain and strengthen the quantitative findings. This design was selected because it enables researchers to obtain a comprehensive understanding of educational phenomena by integrating statistical evidence with participants' experiences and perceptions (Creswell, 2018). The study focused on the integration of educational technology into watercolor painting instruction for junior high school students in Shijiazhuang City, China.

The research was conducted in six junior high schools representing urban and suburban areas in Shijiazhuang, Hebei Province, China. Stratified sampling was employed to ensure the representation of different school characteristics. The participants consisted of 360 students (180 students in the experimental class and 180 students in the control class), 12 art teachers, and 6 school administrators. Students participated in the teaching intervention, while teachers and administrators contributed to the questionnaire survey and semi-structured interviews. The intervention was implemented over one academic semester. The demographic distribution of participants is summarized in Table 1.

Table 1. Research Participants

Participants	Sampling Technique	Number
Junior high school students	Stratified cluster sampling	360
Art teachers	Purposive sampling	12
School administrators	Purposive sampling	6
Total		378

During the quantitative phase, the participating schools were divided into an experimental group and a control group. Students in the experimental group received an integrated instructional model combining educational technology with watercolor painting instruction, including multimedia learning resources, digital painting software, online collaborative platforms, and virtual learning experiences. In contrast, the control group received conventional watercolor instruction using traditional demonstration-based teaching methods. Pre-test and post-test assessments were administered to evaluate students' watercolor painting skills, learning interest, and core competencies before and after the intervention.

Data were collected using multiple instruments, including questionnaires, semi-structured interview guides, classroom observation sheets, students' artwork assessment rubrics, and document analysis. Three structured questionnaires were developed for teachers, students, and school administrators using a five-point Likert scale. Prior to the main study, pilot testing was conducted to evaluate the quality of the instruments. The reliability coefficients (Cronbach's alpha) were 0.86 for the teacher questionnaire, 0.83 for the student questionnaire, and 0.81 for the administrator questionnaire, indicating satisfactory internal consistency. Content validity was established through expert judgment, resulting in a Content Validity Index (CVI) of 0.88. A summary of the research instruments is presented in Table 2.

Table 2. Research Instruments

Instrument	Respondents	Purpose	Reliability
Teacher Questionnaire	Teachers	Educational technology integration	$\alpha = 0.86$
Student Questionnaire	Students	Learning interest and learning experience	$\alpha = 0.83$



Instrument	Respondents	Purpose	Reliability
Administrator Questionnaire	Administrators	School support	$\alpha = 0.81$
Watercolor Skill Test	Students	Learning achievement	Test–retest = 0.82
Artwork Rubric	Students	Creativity and painting performance	Inter-rater = 0.85
Interview Guide	Teachers, Students, Administrators	Explore experiences and perceptions	Expert validated
Observation Sheet	Classroom	Observe teaching implementation	Expert validated

Following the quantitative phase, qualitative data were collected through semi-structured interviews with 12 art teachers, 24 students, and 6 school administrators, accompanied by classroom observations and document analysis. The interviews explored participants' experiences, perceptions, implementation challenges, and recommendations regarding the integration of educational technology into watercolor instruction. Classroom observations were conducted throughout the intervention to document instructional practices, student engagement, and teacher–student interactions. Students' watercolor artworks were also analyzed to identify changes in creativity, artistic expression, and technical competence.

Quantitative data were analyzed using SPSS version 26. Descriptive statistics were employed to summarize participants' responses, while inferential statistics, including independent-samples *t*-tests, paired-samples *t*-tests, one-way ANOVA, Pearson correlation analysis, and multiple regression analysis, were used to examine differences and relationships among the study variables. Qualitative data were analyzed using thematic analysis following grounded theory coding procedures (Strauss, A., 1998), consisting of open coding, axial coding, and selective coding to identify core themes from participants' experiences. Finally, quantitative and qualitative findings were integrated through triangulation to generate comprehensive interpretations and strengthen the credibility of the research findings (Creswell, 2018; Miles, 2020). The analytical framework used in this study is summarized in Table 3.

Table 3. Data Analysis Techniques

Research Objective	Data Source	Analysis Technique
Examine current implementation	Questionnaire	Descriptive statistics
Compare experimental and control groups	Pre-test and post-test	Independent and paired-samples <i>t</i> -tests
Compare different participant characteristics	Test scores	One-way ANOVA
Examine relationships among variables	Questionnaire	Pearson correlation
Identify significant predictors	Questionnaire and achievement test	Multiple regression
Explore participants' experiences	Interview and observation	Grounded theory coding
Integrate findings	Quantitative and qualitative results	Triangulation

To ensure research rigor, both quantitative and qualitative quality criteria were applied. Instrument validity was examined through content validity and construct validity,



while reliability was evaluated using Cronbach's alpha, test–retest reliability, and inter-rater reliability. Qualitative trustworthiness was enhanced through methodological triangulation, detailed documentation of the research process, and member verification where appropriate (Lincoln, 1985). Furthermore, ethical principles were maintained throughout the study by obtaining informed consent from all participants, ensuring confidentiality and anonymity, and using the collected data exclusively for academic purposes.

Results and Discussion

Pre-test Equivalence between Experimental and Control Groups

Before the instructional intervention, an independent samples t-test was conducted to ensure that both groups had comparable baseline abilities in watercolor painting skills, learning interest, and core competencies. The Pre-test Comparison between Experimental and Control Groups in this study is summarized in Table 4.

Table 4. Pre-test Comparison between Experimental and Control Groups

Variable	Experimental (n=180) Mean ± SD	Control (n=180) Mean ± SD	t	p
Watercolor Skills	67.84 ± 8.52	68.11 ± 8.36	-0.31	0.758
Learning Interest	3.21 ± 0.48	3.18 ± 0.51	0.57	0.569
Aesthetic Judgment	3.34 ± 0.43	3.32 ± 0.46	0.41	0.683
Creative Thinking	3.27 ± 0.47	3.25 ± 0.49	0.38	0.704
Collaborative Ability	3.30 ± 0.45	3.29 ± 0.44	0.22	0.826

Pre-test results indicate no significant differences between the experimental and control groups across all variables including watercolor skills, learning interest, and core competency aspects such as aesthetic judgment and creative thinking. This equivalent baseline aligns with findings by (Mishra & Koehler, 2006) and (UNESCO, 2023), which confirm that traditional art instruction at the secondary school level generally reflects similar, conventional skill levels prior to the introduction of structured technological interventions. These initial findings also support the connectivism framework (Redecker, 2017), wherein student motivation and skills remain sub-optimally stimulated in the absence of digital information network integration.

Although prior research such as that by (Bond, 2020) and (Koehler et al., 2013)—has demonstrated that technologies like virtual reality and digital painting software can enhance student engagement and creative exploration, these studies suffer from a key limitation: they focus exclusively on digital media (purely digital painting) while overlooking the learning of physical techniques. In contrast to such approaches, this study challenges the assumption that technology must replace traditional media. Pre-test data indicate that students' physical watercolor skills started at a baseline level, underscoring the continued need for the hands-on, tactile experiences (Eisner, 2022) that research on purely digital media has failed to address. Furthermore, in many schools, technology is often utilized merely as a passive presentation medium (Mishra & Koehler, 2006) rather than as an interactive tool to support analog art instruction.

Post-test Comparison

Following sixteen weeks of instructional intervention, significant improvements were observed in the experimental group. The Post-test Comparison between Experimental and Control Groups in this study is summarized in Table 5.



Table 5 Post-test Comparison between Experimental and Control Groups

Variable	Experimental Mean $\pm$ SD	Control Mean $\pm$ SD	t	P
Watercolor Skills	86.74 $\pm$ 6.81	76.42 $\pm$ 7.54	12.58	<0.001
Learning Interest	4.43 $\pm$ 0.39	3.65 $\pm$ 0.48	15.34	<0.001
Aesthetic Judgment	4.38 $\pm$ 0.36	3.71 $\pm$ 0.44	14.19	<0.001
Creative Thinking	4.41 $\pm$ 0.35	3.58 $\pm$ 0.46	17.46	<0.001
Collaborative Ability	4.47 $\pm$ 0.33	3.69 $\pm$ 0.43	16.83	<0.001

Results from the 16-week intervention indicate that the experimental group achieved significantly higher performance than the control group in watercolor skills and aesthetic judgment. These findings align with previous research (Bond, 2020; Mayer, 2021), highlighting that the integration of digital tools and multimedia enhances students' artistic exploration and understanding of aesthetic values. This improvement occurred because digital portfolios and virtual exhibitions allowed students to dynamically observe complex color-mixing techniques before practicing them on paper, thereby overcoming the limitations of passive demonstrations inherent in conventional instruction (Mishra & Koehler, 2006). Unlike studies focusing solely on digital painting software (Koehler et al., 2013), this research demonstrates that technology actually stimulates and reinforces the mastery of traditional watercolor techniques rather than replacing them (Eisner, 2022).

Furthermore, the intervention resulted in significant increases in learning interest and collaborative skills, with the most substantial gains observed in creative thinking. This supports the theoretical framework of connectivism (Redecker, 2017; Trust, 2018) which posit that digital networks and online collaborative platforms foster active by shifting from teacher-centered instruction to network-based peer feedback and digital gallery walks. In contrast to technology usage that is often limited to passive presentation tools (Mishra & Koehler, 2006) or detached from local contexts (UNESCO, 2023), the key driver of this creativity boost was the integration of local Shijiazhuang cultural elements into the digital modules as thematic inspiration. This study addresses gaps in prior research by demonstrating that embedding local cultural heritage into technology-based watercolor instruction creates an effective, contextual pathway for developing the core competencies of junior high school students.

Pre-test and Post-test Improvement

A paired-samples t-test examined learning improvement within each group in this study is summarized in Table 6.

Table 6. Improvement from Pre-test to Post-test

Variable	Experimental Mean Gain	Control Mean Gain	P
Watercolor Skills	+18.90	+8.31	<0.001
Learning Interest	+1.22	+0.47	<0.001
Aesthetic Judgment	+1.04	+0.39	<0.001
Creative Thinking	+1.14	+0.33	<0.001
Collaborative Ability	+1.17	+0.40	<0.001

Paired-samples t-test results indicate that the experimental group achieved a significantly higher mean improvement across all variables compared to the control group, particularly in watercolor skills and aesthetic judgment. These findings align with previous research (Bond, 2020; Mayer, 2021), confirming that technology-based learning effectively accelerates artistic progress and aesthetic understanding. Significant improvements in physical watercolor skills occurred because digital demonstrations and virtual portfolios



helped students visualize color-mixing dynamics prior to hands-on practice. Unlike earlier studies focusing solely on digital media this research demonstrates that technology acts as a catalyst for accelerating the mastery of traditional watercolor techniques rather than replacing them (Eisner, 2022).

Furthermore, the intervention fostered substantial growth in learning interest and collaborative abilities, alongside a surge in creative thinking that more than tripled that of the control group. These improvements reinforce connectivism theory (Redecker, 2017; Trust, 2018), by facilitating a transition from passive, teacher-centered instruction to an active ecosystem based on online peer critique. In contrast to technology usage that is often fragmented (Mishra & Koehler, 2006) or disconnected from the students' context (UNESCO, 2023) the key driver of this surge in creativity was the incorporation of Shijiazhuang's local cultural heritage into the digital modules. This study addresses gaps in previous research by demonstrating that integrating local cultural heritage with technology is a powerful mechanism for building core student competencies in secondary art education.

Correlation Analysis

Pearson correlation analysis was performed to examine relationships among instructional variables in this study is summarized in Table 7.

Table 7. Correlation Matrix

Variable	Instructional Design	Classroom Interaction	Learning Motivation	Learning Outcomes
Instructional Design	1	.68**	.71**	.74**
Classroom Interaction	.68**	1	.76**	.73**
Learning Motivation	.71**	.76**	1	.78**
Learning Outcomes	.74**	.73**	.78**	1

p < .01

All variables showed significant positive correlations, indicating that better instructional design and richer classroom interaction contributed to stronger learning motivation and improved learning outcomes.

Multiple Regression Analysis

Multiple regression was used to identify significant predictors of students' learning outcomes in this study is summarized in Table 8 and Model summary in this study is summarized in Table 9.

Table 8. Multiple Regression Analysis

Predictor	B	T	P
Educational Technology Competence	.36	6.74	<0.001
Instructional Design	.31	5.98	<0.001
Classroom Interaction	.24	4.92	<0.001
Digital Learning Resources	.19	3.87	<0.001

Table 9. Model Summary:

R	R ²	Adjusted R ²	F	P
.795	.632	.624	78.45	<0.001

The regression model explained **63.2%** of the variance in students' learning outcomes, indicating a strong predictive model.



Qualitative Findings

Qualitative data from interviews and observations provide real-world context that reinforces the quantitative findings across four key themes.

Theme 1: Enhanced Learning Experience and Reduced Creative Anxiety Among Students

The use of Virtual Reality (VR) and digital painting tools proved effective in lowering barriers associated with watercolor painting, thereby fostering improvements in students' technical skills and motivation. Digital tools offer a risk-free space for experimenting with color mixing before applying paint to physical paper. An 8th-grade student remarked:

"In traditional classes, I was always afraid of making mistakes because wet paper easily gets damaged or muddy when corrected. However, using VR and digital painting tools allowed me to test color blending and gradients multiple times first. It eliminated my fear of failure and gave me much more confidence when applying actual watercolor on paper."

This interactive visualization transforms passive imitation into active exploration, encouraging students' creative expression.

Theme 2: Instructional Transformation and the Burden of Preparation for Teachers

Teachers reported a shift in classroom dynamics from conventional demonstrations to active, student-centered learning. These findings align with the regression analysis, which identified teacher technological competence as a primary predictor of learning success. However, the workload associated with lesson preparation increased significantly. A senior art teacher noted:

"The integrated model completely reinvigorated classroom engagement. Instead of passively watching me paint, students actively experiment with digital and physical media. But honestly, the lesson preparation workload has increased dramatically. We must design VR scenarios, curate digital courseware, and troubleshoot equipment before every class."

This feedback underscores that the sustainability of this model relies heavily on continuous training and technical support for teachers.

Theme 3: Institutional Support, Cultural Integration, and Infrastructural Disparities

School administrators highlighted the importance of integrating local cultural elements—such as the Zhaozhou Bridge in Shijiazhuang into the digital art curriculum to strengthen students' cultural identity. On the other hand, ensuring equitable facilities across schools presents a major challenge. A deputy principal stated:

"Integrating local cultural heritage through digital media enriches the curriculum's depth and strengthens students' cultural identity. However, scaling this model effectively requires addressing hardware and maintenance disparities between urban key schools and suburban institutions, as well as providing continuous teacher training."

perspective indicates that school policies and infrastructure equity are crucial moderating factors in the implementation of technology based art education.

Theme 4: Classroom Interaction Dynamics and Collaborative Learning Environments

Classroom observation notes confirmed a surge in students' creative thinking scores and collaborative abilities. Interactive digital platforms successfully shifted the dynamic from one-way lectures to a network of peer-to-peer feedback. Observation notes recorded:

"In the experimental classrooms, active student engagement exceeded 85%. Students routinely gathered around interactive digital platforms to critique peer proposals and



exchange techniques prior to final physical execution. The classroom atmosphere was noticeably dynamic, self-directed, and collaborative compared to the control group." Overall, these qualitative findings demonstrate that the technology based watercolor learning model is not only statistically effective but also meaningful and practical for classroom implementation.

Discussion

The empirical findings of this study demonstrate that integrating educational technology into watercolor instruction at the junior high school level significantly enhances students' technical painting skills and aesthetic judgment. These findings align with previous studies (Mayer, 2021; Zhao & Frank, 2003), onfirming that multimedia visualization and digital tools accelerate aesthetic understanding and artistic exploration. However, while current literature largely focuses on purely digital painting software that replaces traditional physical media (Park, H., & Kim, 2022; Wang, L., & Chen, 2024), this research offers a distinct perspective. The study proves that digital resources, Virtual Reality (VR), and interactive demonstrations can be systematically utilized as visualization bridges to reinforce rather than replace conventional tactile watercolor techniques (Eisner, 2022) Within this framework, technology assists students in visualizing color-mixing dynamics before applying paint to paper.

Furthermore, regression analysis identifies teachers' technological competence as the strongest predictor of student learning outcomes, followed by significant improvements in collaborative skills. This reinforces the view held by (Li, Y., & Liu, 2023) that the success of technology integration relies heavily on teachers' Technological Pedagogical Content Knowledge (TPACK), rather than merely on the availability of hardware. While earlier research (Santos et al, 2022) found that technology in art classrooms was often limited to passive presentation tools, the blended learning model in this study successfully activated collaborative platforms and peer-critique networks. This shift effectively transformed the learning environment from a teacher-centered model into an active, collaborative ecosystem grounded in connectivism theory.

The most notable improvement resulting from this intervention is observed in the students' creative thinking abilities. While global frameworks typically evaluate digital creativity within abstract or generic urban settings (Smith, A., & Zhang, 2025; UNESCO, 2023), this study offers significant contextual novelty. The systematic integration of Shijiazhuang's local cultural heritage into digital learning modules proved to be a key mechanistic driver of student creativity. By embedding local cultural values into technology based art education, this model not only hones technical and digital competencies but also deepens the learners' cultural awareness and contextual engagement.

Conclusion

This study demonstrates that integrating educational technologies such as digital learning resources, virtual reality (VR), digital painting software, and online collaboration platforms into watercolor painting instruction in Shijiazhuang junior high schools significantly enhances students' learning interest, technical painting skills, aesthetic appreciation, creative thinking, collaborative abilities, and overall core competencies. These findings confirm that educational technology serves not merely as a conventional teaching aid but as a transformative pedagogical approach that enriches the learning experience and fosters meaningful student engagement. Furthermore, the success of the proposed model underscores that effective technology integration requires careful alignment among



technological resources, pedagogical strategies, art learning activities, and the achievement of competency-based educational goals.

Theoretically, this study expands the literature on the application of educational technology within the specific and under-researched discipline of watercolor painting by providing a holistic learning framework that integrates technological, pedagogical, and artistic dimensions alongside core competencies into a unified model. The study also reinforces constructivist theory by demonstrating that the effectiveness of technology depends not merely on the availability of digital devices, but on teachers' technological competence, the design of learning activities, and the establishment of a collaborative environment. From a practical standpoint, this research offers evidence-based guidance for art teachers, school principals, and curriculum developers on integrating traditional watercolor techniques with digital technology, while emphasizing the importance of strengthening infrastructure and providing continuous teacher training. Furthermore, for policymakers, these findings encourage the formulation of strategic curricula that leverage technology to preserve, interpret, and disseminate local cultural heritage through responsive and contextual art education.

Recommendation

Visual arts teachers at the junior high school level are encouraged to integrate educational technology such as interactive multimedia, digital painting software, and collaborative platforms into watercolor instruction to foster engaging, student centered learning. At the institutional level, schools must provide adequate technology infrastructure, digital resources, and ongoing professional development to boost teachers' TPACK competencies. Concurrently, policymakers should allocate budgets, formulate supportive policies, and design evaluation frameworks that promote technology integration while preserving local cultural heritage.

Future research should expand to broader, more diverse contexts and evaluate the long-term impacts of technology-enhanced art education. Additionally, scholars are encouraged to explore emerging technologies including artificial intelligence (AI), augmented reality (AR), and adaptive learning systems to further enhance student creativity, aesthetic appreciation, and digital literacy.

References

- Bond, M. . B. S. . M. V. I. . & H. M. (2020). Emergency remote teaching in higher education: Mapping the first global online semester. *International Journal of Educational Technology in Higher Education*, 44(17). <https://doi.org/https://doi.org/10.1186/s41239-020-00225-6>
- Creswell, J. W. . & C. J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches . Sage Publications. <https://doi.org/https://us.sagepub.com/en-us/nam/research-design/book255675>
- Eisner, E. W. (2022). *The arts and the creation of mind*. Yale University Press. <https://doi.org/https://yalebooks.yale.edu/book/9780300095233/the-arts-and-the-creation-of-mind/>
- Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types. *Journal of Research on Technology in Education*, 41(4), 393–416. <https://doi.org/10.1080/15391523.2009.10782536>
- Koehler, M. J., Mishra, P., & Cain, W. (2013). What is Technological Pedagogical Content



- Knowledge (TPACK)? *Journal of Education*, 193(3), 13–19. <https://doi.org/10.1177/002205741319300303>
- Li, Y., & Liu, X. (2023). Teacher TPACK competence as the key determinant of educational technology integration success in secondary schools. *Journal of Educational Computing Research*, 61(4), 812–835.
- Lincoln, Y. S. . & G. E. G. (1985). *Naturalistic inquiry*. Sage Publications. <https://us.sagepub.com/en-us/nam/naturalistic-inquiry/book842>
- Mayer, R. E. (2021). *Multimedia Learning*. <https://doi.org/https://doi.org/10.1017/9781316941354>
- Miles, M. B. . H. A. M. . & S. J. (2020). *Qualitative data analysis: A methods sourcebook (4th ed.)*. Sage Publications.
- Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Park, H., & Kim, J. (2022). Replacing traditional brushwork: Evaluating the transition to pure digital painting platforms in secondary art education. *Computers & Education*.
- Redecker, C. (2017). *European framework for the digital competence of educators: DigCompEdu*. Publications Office of the European Union. <https://doi.org/https://doi.org/10.2760/159770>
- Santos et al. (2022). Passive integration versus active engagement: Re-evaluating technology use in secondary art classrooms. *Art Education Policy Review*, 123(2), 94–108.
- Smith, A., & Zhang, W. (2025). Decontextualized digital creativity: Evaluating contemporary global frameworks in secondary education. . . *International Journal of Educational Research*.
- Strauss, A., & C. (1998). *Basics of qualitative research: Techniques and procedures for developing grounded theory (2nd ed.)*. SAGE Publications.
- Trust, T. (2018). Why do teachers need professional learning networks? . *Journal of Digital Learning in Teacher Education*, 34(2), 85–87. <https://doi.org/https://doi.org/10.1080/21532974.2017.1398374>
- UNESCO. (2023). *Global education monitoring report 2023: Technology in education—A tool on whose terms?* . <https://doi.org/https://unesdoc.unesco.org/ark:/48223/pf0000385723>
- United Nations. (2023). *Transforming our world: The 2030 agenda for sustainable development*. <https://doi.org/https://sdgs.un.org/2030agenda>
- Wang, L., & Chen, H. (2024). Digital media substitution in visual art instruction: A comparative study on student skill acquisition. *Interactive Learning Environments*, 32(3), 1420–1438.
- Zhao, Y., & Frank, K. A. (2003). Factors Affecting Technology Uses in Schools: An Ecological Perspective. *American Educational Research Journal*, 40(4), 807–840. <https://doi.org/10.3102/00028312040004807>