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Empirical Research on Online Software Assisted Sketching Instruction

Huang Lian*

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Abstract

Purpose: This study evaluates the effectiveness of the online education software Meishubao in blended sketching instruction, focusing on its impact on high school students' exam-oriented core sketching abilities. **Research design, data and methodology:** Using a quasi-experimental design, 72 high school art students were randomly assigned to an experimental group (Meishubao-assisted blended teaching) or a control group (traditional face-to-face instruction) for an eight-week intervention. Students were pre- and post-tested on composition, perspective, spatial experience, richness of detail, and aesthetic sensitivity, based on Sichuan Province Art Joint Examination criteria. Independent-samples t-tests were conducted in Jamovi. **Results:** The experimental group demonstrated significantly greater post-test gains in composition, perspective, spatial experience, and richness of detail than the control group, with no significant difference in aesthetic sensitivity. **Conclusions:** Meishubao addresses limitations of traditional instruction—such as monotonous skill drills and insufficient individualized guidance—by offering real-time feedback and personalized learning paths, thereby significantly improving sketching outcomes in blended settings. Implications and future directions: The findings provide empirical support for the digital transformation of art education and suggest that Meishubao-enabled blended learning is a promising exam preparation strategy. Future studies should expand sample size and duration and explore AI-optimized interactive modes. To further advance technology-supported art education.

Keywords: Sketch, Art Education, Formative Drawing Meishubao

1. Introduction

The rapid evolution of information technology in the 21st century is instigating unprecedented transformations within the educational landscape. Traditional pedagogical models are increasingly being supplemented or replaced by more flexible, interactive, and resource-rich online learning platforms (Zhu & Berry, 2018). In the specific domain of art education, sketch training holds a fundamental position, playing a crucial role in artistic creation and design, and is particularly significant for professional foundational training (Avotina et al., 2023; Marek & Kirchner, 2016). In China, sketching constitutes a core component of the National College Entrance Examination (NCEE) for art majors, making the effective enhancement of high school students' sketching skills a matter of practical importance (Fang et al., 2022; Yuan, 2015).

However, traditional sketch teaching methods, predominantly confined to face-to-face instruction, often struggle to meet the demands of modern quality-oriented education (Zhu & Berry, 2018). Key challenges include mastering monotonous basic skills, understanding complex principles of composition, perspective, and spatial relationships, and, critically, the lack of sufficient personalized guidance due to time constraints and inadequate resources in many schools (Kelley & Sung, 2017; Williford et al., 2020). Consequently, these limitations frequently lead to dampened student interest and suboptimal learning outcomes.

Concurrently, the proliferation of mobile Internet technology has catalyzed the widespread adoption of online education software, celebrated for its convenience, interactivity, and capacity for instant feedback (Golonka et al., 2014). These digital tools can simulate realistic painting

1* Huang Lian, , Chengdu University of Information Technology, China. Email: 2397941721@qq.com

environments, offer diverse material libraries, and provide customized learning pathways to help users overcome learning obstacles. Applications specifically designed for sketching skills training, such as Meishubao, offer structured course systems and multi-level practice modes, presenting a potential solution to the constraints of traditional pedagogy.

Nevertheless, while existing scholarship has substantiated the efficacy of online software in enhancing efficiency in domains like language learning (Golonka et al., 2014), its application within art education, particularly in sketch instruction, remains relatively underexplored. Research on how such technologies can be leveraged to improve teaching effectiveness in this specific field is still in its nascent stages.

To address this research gap, this study aims to investigate the impact of integrating the online education software Meishubao into blended sketch teaching for high school art students. Focusing on core competencies essential for college entrance examinations—composition, perspective, spatial experience, detail richness, and aesthetic sensibility—this research compares Meishubao-assisted blended learning against traditional face-to-face instruction. A quasi-experimental design was employed, involving 72 high school art students randomly assigned to an experimental group (blended learning with Meishubao) or a control group (traditional teaching). Following an 8-week intervention, post-test data were analyzed to evaluate the software's effectiveness.

This study seeks to provide empirical evidence on whether and how online software like Meishubao can enhance sketch learning outcomes by mitigating the limitations of traditional methods, such as monotonous skill training and insufficient individualized guidance. The findings are anticipated to offer valuable theoretical support and practical references for the ongoing digital transformation of art education, suggesting innovative strategies for exam preparation and potentially contributing to the advancement of more efficient and inclusive art education practices globally.

2. Literature Review

2.1 Composition of Picture

The composition of a picture refers to the process and art of organizing and arranging visual elements—such as lines, shapes, colors, and textures—within a two-dimensional plane to form a coherent, balanced, and meaningful whole (McCurdy & Arnheim, 1955; Tytenko, 2021). In artistic creation, particularly in sketching, it serves as a fundamental framework that guides the viewer's eye and conveys the creator's intended message or emotion. Key principles include balance, proportion, symmetry, focus, and the use of leading lines, all of which collectively determine the aesthetic value and communicative power of the artwork (McCurdy & Arnheim, 1955). For high school students mastering sketching, proficiency in composition is not merely a technical skill but a critical component of visual literacy, enabling them to effectively plan and design works that clearly communicate information to the audience (Vuk & Bosnar, 2021).

The integration of technology has introduced new dimensions to teaching and assessing compositional skills. Online software and digital tools can provide learners with instant, objective feedback on their compositional choices, helping them understand and practice these principles more effectively than through traditional methods alone (Hautopp & Buhl, 2020). For instance, some platforms feature analytical tools like heat maps that visualize areas of interest and color distribution within a frame, offering data-driven insights into the effectiveness of a composition (Brumberger, 2021). Furthermore, the digital environment allows for easy experimentation with different layouts and elements, lowering the barrier to creative exploration and iteration (Kwon & Morrill, 2022).

Empirical research on composition assessment often employs a mixed-methods approach. Quantitative analyses utilize detailed scoring rubrics that deconstruct composition into evaluable components like subject placement, background treatment, and color harmony (Dudea et al., 2016). Qualitatively, methods such as student interviews and think-aloud protocols are used to gain deeper insight into the creative decision-making process behind the composition, aspects that are difficult to capture through visual assessment alone (Saeedakhtar et al., 2021). Therefore, composition is not only a core teaching content in art education but also a key indicator for measuring students' artistic performance. The application of online software provides new opportunities for composition teaching and promotes a more precise and multi-dimensional evaluation.

H1: There is a significant improvement in the composition of picture ability between the control group (traditional teaching) and the treatment group (Meishubao-based teaching) in the post-test.

2.2 Painting Perspective

Painting perspective encompasses the techniques and cognitive abilities that enable an artist to accurately represent three-dimensional space and the spatial relationships between objects on a two-dimensional surface (Berger, 2018). It involves a sophisticated understanding of geometric principles (linear perspective) and the atmospheric effects that influence how we perceive distant objects (aerial perspective) (Hagen & Hagen, 2003). Mastery of perspective is crucial for enhancing the realism, depth, and immersive quality of a sketch, directly impacting its believability and visual impact (Talbot, 2003). For students, it is a challenging yet essential skill that bridges observation with technical execution.

Digital learning platforms offer significant advantages in teaching complex perspective concepts. They can provide dynamic simulation tools, interactive tutorials, and 3D modelling functions that allow students to visualize and manipulate perspective principles in ways static images cannot (Tan, 2024). This interactive, theory-practice combined approach helps improve students' visual analysis and spatial perception skills, thereby enhancing their expressive power in sketching (Tan, 2024; Zhao & Lai, 2022). The ability to receive immediate feedback on the accuracy of their perspective drawings allows students to quickly identify and correct errors, reinforcing correct techniques (Jianwu et al., 2024).

The measurement of painting perspective proficiency typically involves assessing the accuracy of its application in student works. This can be done through standardized scoring systems that evaluate everything from simple one-point to complex multi-point perspective (Franklin et al., 1992). The data recording capabilities of modern drawing software provide an additional layer of objective assessment by tracking specific student actions and corrections during the drawing process (Jianwu et al., 2024). Beyond quantitative scores, qualitative feedback gathered through surveys or interviews is vital for understanding the challenges students face and their conceptual grasp of perspective (Saeedakhtar et al., 2021). Technology-assisted assessments, including automated analysis algorithms, are increasingly being used to provide efficient and intuitive evaluations of student progress (Brumberger, 2021).

H2: There is a significant improvement in the painting perspective ability between the control group and the treatment group in the post-test.

2.3 Spatial Experience

Spatial experience in sketching refers to an individual's ability to perceive, comprehend, interpret, and effectively render the three-dimensional structure of objects and their interrelationships within a given space onto a two-dimensional plane (Gibson, 1979). It extends beyond mere technical drawing to include the cognitive processes of mental visualization, manipulation of spatial images, and the hand-eye coordination required for precise execution (McCurdy & Arnheim, 1955; Na et al., 2022; Paivio, 2008). A well-developed spatial experience allows students to create a convincing sense of depth, volume, and environment in their sketches, which is fundamental to advanced artistic expression (Tversky, 2014).

The role of technology, particularly online software, in fostering spatial skills is profound. Virtual Reality (VR) and Augmented Reality (AR) technologies can provide immersive experiences that allow students to explore and interact with 3D models from various angles, drastically enhancing their understanding of form and space (Kwon & Morrill, 2022). Furthermore, digital tools that simulate real-world spatial relationships can strengthen students' conceptual understanding far beyond what is possible through traditional observation alone (Zhao & Lai, 2022). This is particularly beneficial for complex spatial problems that require strong mental imagination and creative thinking to solve (Paivio, 2008).

Measuring spatial experience involves a combination of direct and indirect methods. Direct measurement often involves expert evaluation of students' sketchwork based on predefined criteria for spatial accuracy and depth representation (Shimada et al., 2016). Indirect measurement utilizes psychometric scales, questionnaires, and performance on specific tasks like virtual navigation or 2D-to-3D conversion tests to infer spatial cognitive ability (Sun et al., 2019). A robust approach often combines both; for example, having students complete a spatial drawing task on a digital platform and subsequently analyzing their work while collecting feedback through semi-structured interviews (Tzeng et al., 2007). This multi-faceted approach provides a comprehensive understanding of the development of students' spatial experience.

H3: There is a significant improvement in the spatial experience ability between the control group and the treatment group in the post-test.

2.4 Detail and Richness

Detail and richness in a sketch refer to the density of information, the level of precision in execution, and the complexity of textures, tones, and nuances that a student incorporates into their work (Dewey, 2019). It is not simply about the quantity of elements but the quality of their relationships, the achieved sense of layering, and the depth of expression (Ritchie, 2012). This variable is a culmination of a student's observational skills, their mastery of various drawing techniques (e.g., line quality, tonal variation), and their capacity for creative thinking that adds unique perspectives and personal style beyond mere replication of reality (McCurdy & Arnheim, 1955). High levels of detail and richness significantly enhance the appeal, realism, and communicative power of an artwork (Xi & E. Sakay, 2024).

Online drawing software is particularly effective in supporting the development of these skills. These platforms are typically equipped with advanced editing tools, such as high-resolution canvases, layer management, and a vast array of digital brushes, which allow students to explore and refine details with a level of control and flexibility that is often difficult to achieve with physical media (Merzdorf et al., 2023). The ability to zoom in infinitely, undo mistakes, and experiment without the fear of wasting materials encourages students to focus on intricate details and complex textures, thereby fostering both technical proficiency and creative exploration (Ritchie, 2012).

The assessment of detail and richness often employs direct evaluation methods, where expert raters score student works against standardized criteria that include line quality, compositional accuracy, and the rendering of light and shadow (Kosslyn, 1982; Lambert, 2005). While this method provides high-fidelity assessment, it is resource-intensive. Indirect measures, such as analyzing user interaction data with drawing software (e.g., time spent on detail work, number of layers used) or employing automated analysis of image complexity, offer scalable supplementary data (Merzdorf et al., 2023). A comprehensive evaluation often considers both the technical execution of details and the manifestation of personal style and creativity.

H4: There is a significant improvement in the detail an drichness of sketch between the control group and the treat ment group in the post-test.

2.5 Aesthetic Sensibility

Aesthetic sensibility denotes an individual's capacity for sensitivity, interpretation, appreciation, and emotional response to art and aesthetic experiences (Uribe, 2013). In the context of high school sketch education, it encompasses a student's ability to perceive subtle visual information (color, form, texture, composition), critically interpret the meaning and intent behind artworks, and emotionally connect with the creative process (Lese, 2015). It is deeply intertwined with personal taste, cultural awareness, and the ability for self-expression and critical reflection (González-Zamar & Abad-Segura, 2021; Haanstra, 1996). Cultivating aesthetic sensibility is key to moving beyond technical mimicry to creating personally meaningful and culturally aware art.

Online platforms play a transformative role in developing aesthetic sensibility by providing unprecedented access to a global repository of art across different cultures, eras, and styles (Haanstra, 1996). This exposure helps students broaden their artistic horizons, understand diverse aesthetic values, and develop their own critical evaluation criteria (Lese, 2015). Furthermore, built-in community features that allow students to share their work and receive feedback from peers and instructors are crucial for developing critical thinking and aesthetic judgment (González-Zamar & Abad-Segura, 2021). This social interaction fosters an environment where students can articulate their feelings about art, compare interpretations, and refine their aesthetic perspectives.

Measuring aesthetic sensibility is inherently challenging due to its subjective nature. The most common method involves having expert reviewers (e.g., art educators, artists) assess artworks created under controlled conditions based on established criteria for artistic value, emotional expression, and creativity (McCurdy & Arnheim, 1955). However, this method can be costly and subject to rater subjectivity. Consequently, indirect methods are widely used, including standardized questionnaires, experimental tasks using specific artworks as stimuli, and interviews designed to probe individuals' emotional reactions, color preferences, and compositional perceptions (Greb et al., 2017; Helmut et al., 2004). These tools aim to quantitatively and qualitatively capture the nuances of an individual's aesthetic development.

H5: There is a significant improvement in the aesthetic sensibility between the control group and the treatment group in the post-test.

3. Research Methods and Materials

3.1 Research Framework

The conceptual framework of this study is grounded in theories of technology-enhanced learning and its application in art education. It is designed to investigate the impact of integrating the online software Meishubao into the teaching of sketching skills for high school art students. The framework posits that the mode of instruction (independent variable) influences the development of core sketching competencies (dependent variables).

The independent variable in this study is the teaching method, which consists of two levels: Traditional Classroom Teaching: The control group receives instruction solely through face-to-face, teacher-led sessions; Meishubao-based Blended Teaching: The experimental group receives instruction through a blend of traditional face-to-face sessions and guided learning activities using the Meishubao software.

The dependent variables are five key dimensions of sketching proficiency, which are measured quantitatively: Composition of Picture: The ability to organize visual elements effectively. Painting Perspective: The ability to represent three-dimensional space accurately. Spatial Experience: The ability to perceive and depict spatial relationships. Detail and Richness: The level of precision, information density, and textural complexity. Aesthetic Sensibility: The sensitivity to and understanding of artistic quality and expression.

The framework outlines a causal-comparative relationship, hypothesizing that the Meishubao-based blended teaching approach will lead to greater improvement in the dependent variables compared to the traditional approach. This is visually represented in the conceptual model presented in Figure 1.

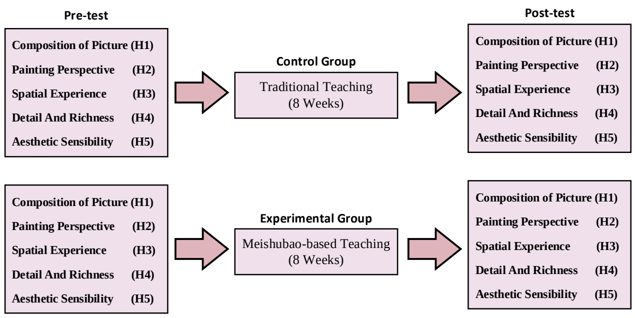

Figure 1: The Conceptual Framework of the Study

3.2 Research Methodology

This study adopted a quasi-experimental research design to systematically explore the research questions and test the hypotheses. A pre-test and post-test control group design was employed to quantitatively compare the sketching skill development between the two groups before and after the 8-week intervention.

The research was conducted in a real-world educational setting at a high school in Chengdu, China. Participants were not randomly assigned to individual groups but were instead assigned based on existing classes to minimize disruption to the school schedule, hence the quasi-experimental nature. This design allows for the observation of changes in the dependent variables while comparing differences between the groups, thereby enabling an evaluation of the intervention's effect (the Meishubao software).

Quantitative data were collected through performance tests based on the scoring standards of the Sichuan Provincial Art College Entrance Examination (ACEE). These tests provided quantifiable scores for each of the five dependent variables. The tests were administered under controlled conditions to ensure fairness and accuracy.

3.3 Population and Sample Size

The target population for this study consisted of approximately 800 high school art freshmen in the Chengdu area. From this population, a sample of 72 beginner-level sketching students was selected from the SL Art School using a purposive sampling technique. Purposive sampling was chosen to ensure that all participants were at a similar starting point in their sketching journey, with limited prior experience, which was a necessary characteristic to effectively investigate the development of their skills (Patton, 2002).

The sample was divided into two groups: Control Group (n=36), Students from Class A who received traditional face-to-face teaching; Experimental Group (n=36), Students from Class B who received Meishubao-based blended teaching.

The sample size was determined with statistical power in mind. Using G*Power software for an independent samples t-test, parameters were set for a two-tailed test with an effect size (d) of 0.8, an alpha error probability of 0.05, and a desired power (1-β err prob) of 0.9. The allocation ratio was set to 1:1. The calculation indicated that a minimum of 34 samples per group was required. To further enhance the validity and reliability of the results, the sample size for each group was increased to 36, as illustrated in Table 1.

Table 1: Population and Sample Size

Group	Population Size	Sample Size	Sampling Method
Control Group (Traditional Teaching)	800	36	Purposive Sampling
Experimental Group (Meishubao-based Teaching)	800	36	Purposive Sampling
Total	800	72	

4. Results and Discussion

4.1 Demographic Profile

This study collected demographic data to characterize the sample participants. A total of 72 beginner sketching students from the SL Art School in Chengdu, China, were included in the final analysis. These participants were divided into a control group (n=36, Class A) and an experimental group (n=36, Class B), both undergoing an 8-week instructional intervention.

As illustrated in Table 2, the sample consisted of 33 male students (45.8%) and 39 female students (54.2%), indicating a relatively balanced gender distribution across the study. The age of participants ranged from 15 to 19 years old. The most prevalent age cohort was 17 years old, comprising 30 students (41.7% of the total sample). This was followed by 16-year-olds (n=16, 22.2%) and 18-year-olds (n=18, 25.0%). The youngest (15 years old) and oldest (19 years old) age groups represented smaller proportions of the sample, with 5 (6.9%) and 3 (4.2%) students, respectively.

Table 2: Demographic Characteristics of Participants (N=72)

Characteristic	Category	Frequency	Percentage (%)
Group	Control Group	36	50.0
	Experimental Group	36	50.0
Gender	Male	33	45.8
	Female	39	54.2
Age	15 years old	5	6.9
	16 years old	16	22.2
	17 years old	30	41.7
	18 years old	18	25.0
	19 years old	3	4.2

4.2 Confirmatory Factor Analysis (CFA)

Prior to the experimental intervention, independent samples t-tests were conducted to ensure the comparability of the control and experimental groups on all five dependent variables. As summarized in Table 3, no statistically significant differences were found between the two groups in their pre-test scores for Composition of Picture ($t(70) = -0.316$, $p = 0.753$), Painting Perspective ($t(70) = -0.490$, $p = 0.626$), Spatial Experience ($t(70) = 1.598$, $p = 0.115$), Detail and Richness ($t(70) = 0.447$, $p = 0.657$), or Aesthetic Sensibility ($t(70) = -1.608$, $p = 0.112$). These results confirm that any post-test differences can be reasonably attributed to the effects of the instructional intervention rather than pre-existing differences.

Table 3: Independent Samples T-test Results for Pre-test Scores

Variable	Group	Mean	SD	t-value	p-value
Composition of Picture	Control Group	16.8	1.28	-0.316	0.753
	Experimental Group	16.7	1.68		
Painting Perspective	Control Group	14.8	1.93	-0.490	0.626
	Experimental Group	15.0	1.92		
Spatial Experience	Control Group	15.2	1.98	1.598	0.115
	Experimental Group	14.5	1.70		
Detail and Richness	Control Group	15.7	1.62	0.447	0.657
	Experimental Group	15.5	2.05		
Aesthetic Sensibility	Control Group	12.1	1.81	-1.608	0.112
	Experimental Group	12.9	2.40		

Descriptive statistics, including means and standard deviations, were calculated for the pre-test and post-test scores of both groups to summarize the central tendency and variability of the data. The results, detailed in Table 4, indicate an increase in mean scores from pre-test to post-test for both groups across all five skill dimensions. However, the experimental group demonstrated substantially greater mean improvements compared to the control group. For instance, the experimental group's mean score for Spatial Experience increased by 1.6 points, whereas the control group's mean increased by only 0.1 points. A similar pattern of markedly greater improvement for the experimental group was observed for Composition of Picture (1.0 vs. 0.2), Painting Perspective (1.3 vs. 0.5), and Detail and Richness (1.5 vs. 0.4). For Aesthetic Sensibility, the experimental group also showed a larger gain (1.2 vs. 0.5).

Furthermore, a reduction in the standard deviation of post-test scores was observed for the experimental group in Composition of Picture, Painting Perspective, and Detail and Richness, suggesting a more consistent performance level and a tighter clustering of scores around the mean after the intervention.

Table 4: Descriptive Statistics of Pre-test and Post-test Scores

Variable	Group	Pre-test		Post-test		Mean Improvement
		Mean	SD	Mean	SD	
Composition of Picture	Control Group	16.8	1.28	17.0	1.32	+0.2
	Experimental Group	16.7	1.68	17.7	1.55	+1.0
Painting Perspective	Control Group	14.8	1.93	15.3	2.03	+0.5
	Experimental Group	15.0	1.92	16.3	1.82	+1.3
Spatial Experience	Control Group	15.2	1.98	15.3	1.83	+0.1
	Experimental Group	14.5	1.70	16.1	1.73	+1.6
Detail and Richness	Control Group	15.7	1.62	16.1	1.42	+0.4
	Experimental Group	15.5	2.05	17.0	1.54	+1.5
Aesthetic Sensibility	Control Group	12.1	1.81	12.6	2.38	+0.5
	Experimental Group	12.9	2.40	14.1	2.45	+1.2

4.3 Structural Equation Model (SEM)

Structural Equation Modeling (SEM) was employed as the primary statistical technique to examine the complex relationships between the independent and dependent variables within the validated research model. SEM allows for the simultaneous testing of multiple hypotheses and provides a comprehensive assessment of the model's overall fit to the collected data.

The model fit was evaluated using a suite of standard goodness-of-fit indices, each with established benchmark criteria recommended in methodological literature. The ratio of the chi-square statistic to degrees of freedom (CMIN/DF) should be less than 3.00 to indicate acceptable fit (Hair et al., 2009). The Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values should exceed 0.90 (Hair et al., 2009). The Goodness-of-Fit Index (GFI) should be greater than 0.85, and the Adjusted Goodness-of-Fit Index (AGFI) should exceed 0.80 (Greenspoon & Saklofske, 1998; Sica & Ghisi, 2007). Finally, the Root Mean Square Error of Approximation (RMSEA) should be below 0.08 to be considered a good fit (Pedroso et al., 2016).

For this study, the SEM analysis was conducted using SPSS AMOS software (version 26). The calculated fit indices for the proposed model are presented in Table 5. The results demonstrate that the model achieved a good fit with the empirical data: CMIN/DF = 2.509, GFI = 0.885, AGFI = 0.862, CFI = 0.938, TLI = 0.931, and RMSEA = 0.055. All values met or surpassed the recommended thresholds, confirming that the theoretical model is a plausible representation of the underlying structure of the variables studied.

Table 5: Goodness-of-Fit Indices for the Structural Model

Fit Index	Recommended Value	Model Value	Reference
CMIN/DF	< 3.00	2.509	(Hair et al., 2009)
GFI	> 0.85	0.885	(Greenspoon & Saklofske, 1998)
AGFI	> 0.80	0.862	(Sica & Ghisi, 2007)
CFI	> 0.90	0.938	(Hair et al., 2009)
TLI	> 0.90	0.931	(Hair et al., 2009)
RMSEA	< 0.08	0.055	(Pedroso et al., 2016)

The satisfactory model fit indicates that the hypothesized relationships between the teaching method (traditional vs. Meishubao-based) and the five core sketching competencies are supported by the data. This provides a solid foundation for proceeding with the interpretation of the path coefficients and the testing of the specific research hypotheses, which are presented in the subsequent section.

4.4 Research Hypothesis Testing Result

To examine the impact of Meishubao-assisted blended learning on high school students' sketching skills, five hypotheses were tested using independent sample t-tests. The results are summarized in Table 6.

Table 6: Hypothesis Testing Results

Hypothesis	Statement	Standardized Effect (Cohen's d)	t-value	p-value	Test Result
H1	Improvement in Composition of Picture	0.61	-2.63	0.010	Supported
H2	Improvement in Painting Perspective	0.60	-2.53	0.013	Supported
H3	Improvement in Spatial Experience	1.14	-4.81	0.001	Supported
H4	Improvement in Detail and Richness	0.75	-3.14	0.002	Supported
H5	Improvement in Aesthetic Sensibility	0.34	-1.43	0.156	Not Supported

Note: All hypotheses were tested at $\alpha = 0.05$. Cohen's d was calculated based on mean differences and pooled standard deviations.

H1-H4 were supported, indicating that the experimental group (Meishubao-assisted learning) showed significantly greater improvement in Composition of Picture, Painting Perspective, Spatial Experience, and Detail and Richness compared to the control group (traditional teaching). The strongest effect was observed in Spatial Experience ($d = 1.14$), suggesting that Meishubao's interactive and immersive features particularly enhance students' spatial understanding and representation skills.

H5 was not supported, indicating that there was no significant difference between the two groups in the improvement of Aesthetic Sensibility. This suggests that while Meishubao effectively supports technical skill development, it may not sufficiently foster higher-order aesthetic judgment, which may require more reflective, critique-based, or culturally contextualized learning experiences.

These findings highlight the strengths of Meishubao in enhancing concrete sketching skills through real-time feedback, personalized practice, and interactive tools, while also pointing to areas where blended or supplementary instructional strategies may be needed to cultivate more abstract competencies such as aesthetic sensibility.

5. Conclusions

5.1 Conclusions

This study investigated the effectiveness of integrating the online software Meishubao into sketch teaching for high school art students, comparing its impact against traditional face-to-face instruction. Through a quasi-experimental design involving 72 students over an eight-week period, the research focused on core sketching competencies including composition, perspective, spatial experience, detail richness, and aesthetic sensibility.

The results demonstrate that Meishubao-assisted blended learning significantly enhances students' sketching skills across most measured dimensions. Specifically, the experimental group showed marked improvements in composition, painting perspective, spatial experience, and detail richness, outperforming the control group that received only traditional instruction. These gains are attributed to Meishubao's interactive features, including real-time feedback, personalized learning paths, video tutorials, and a virtual drawing board, which together create a more engaging and flexible learning environment.

However, no significant difference was found between the two groups in aesthetic sensibility, suggesting that while Meishubao effectively supports technical skill development, it may be less impactful in cultivating higher-order aesthetic judgment and emotional resonance. This indicates a potential area for future enhancement through integrated pedagogical strategies.

The findings underscore the value of digital tools like Meishubao in modernizing art education, particularly in preparing students for high-stakes examinations such as the art college entrance exam. Educators are encouraged to adopt such technologies to complement traditional methods, thereby enriching the learning experience and improving outcomes. Future research should explore long-term effects, broader demographic applicability, and strategies to enhance aesthetic education through digital platforms.

5.2 Recommendations

Based on the analysis of the research results, this paper proposes the following three suggestions to promote the effective application of online software in sketching instruction and provide direction for future related research.

First, for education practitioners, it is important to fully recognize the auxiliary value of online software in enhancing sketching skills. It is recommended that teachers integrate tools such as "Meishubao" into blended learning, utilizing features like video tutorials, virtual drawing boards, and real-time feedback to enrich teaching formats and make up for the lack of personalized guidance in traditional classrooms. Schools and training institutions may consider updating their teaching systems to incorporate such tools into regular teaching plans and provide relevant training for teachers to help them master the ability to conduct differentiated teaching using technology tools.

Second, for platform designers and developers, continuous optimization of technical functions and content construction should be pursued. It is suggested to strengthen AI-driven real-time analysis capabilities, providing more accurate personalized feedback paths in fundamental skills such as composition, perspective, and spatial experience. At the same time, focus should be placed on developing function modules that enhance aesthetic sensitivity, for example, integrating elements of art appreciation, cross-cultural work analysis, virtual galleries, etc., guiding students to develop critical thinking and aesthetic judgment based on mastering techniques.

Third, for research and practical promotion, a more systematic and long-term empirical study needs to be conducted. It is recommended that subsequent research expands the sample range and diversity, including student groups from different regions and with different levels of art foundation, and extends the experimental period to examine the effectiveness of tools like "Meishubao" in the long-term cultivation of artistic literacy. Further technological comparative studies can also be carried out to explore collaborative application models of various digital tools in art education, providing more comprehensive empirical evidence and strategic support for the digital transformation of education.

5.3 Limitation and Further Study

This study employed a quasi-experimental design to examine the impact of Meishubao software on sketching learning, yet several limitations must be acknowledged. First, the sample was limited to 72 art students from a single high school in Chengdu, which may restrict the generalizability of the findings to broader populations with different cultural, educational, or socioeconomic backgrounds. Second, the relatively short intervention period of 8 weeks might not fully capture the long-term effects or sustainability of skill improvement, particularly for complex competencies such as aesthetic sensibility. Third, the reliance on quantitative performance tests, though objective, may overlook nuanced aspects of creative expression and emotional engagement that qualitative approaches could reveal. Finally, the study focused primarily on technical skills, leaving open questions about the software's impact on higher-order capacities such as creative thinking and critical artistic judgment.

Future research should address these limitations through expanded and diversified sampling across multiple institutions and regions to enhance external validity. Longitudinal studies are recommended to track the lasting effects of software-assisted learning over semesters or years. Mixed-methods designs incorporating interviews, reflective journals, and portfolio assessments could provide deeper insights into students' creative processes and emotional responses. Additionally, further investigation is needed to examine how digital tools like Meishubao can be optimized to foster not only technical skills but also aesthetic judgment and innovative thinking, possibly through integrated pedagogical models that combine technology with critical art appreciation and cultural contextualization.

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