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Enhancing teaching effectiveness in ancient architecture colour painting through blended design: An ADDIE model application in vocational education

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Abstract

This study aimed to implement the Analysis, Design, Development, Implementation, Evaluation (ADDIE) model to enhance the effectiveness of teaching colour painting in the training of future professionals. The methodology involved analysing the current teaching state of this course at Henan Technical College of Construction, combining traditional education with the application of the ADDIE model. A comparative analysis was conducted between the learning outcomes of students using the ADDIE model and those taught using traditional methods. The ADDIE model facilitated the improvement of course structure, established clear learning objectives, and developed assessment mechanisms that took into account both theoretical knowledge and practical skills. The results of the study revealed significant improvements in students' abilities, with the experimental group, using the ADDIE model, scoring an average of 82% compared to the control group's 68% on knowledge-based assessments. In terms of practical skills, the experimental group achieved a score of 78%, a notable increase from the 62% scored by the control group. Additionally, critical thinking levels in the experimental group rose to 75%, compared to 60% in the control group. These outcomes highlight the positive impact of the ADDIE model in enhancing both theoretical and practical aspects of student learning. The integration of blended design led to increased student engagement and interest in the subject, fostering the development of creative thinking and visual perception. The results also indicated that students in the experimental group demonstrated greater autonomy and motivation to learn, as evidenced by their higher levels of engagement in group projects and creative tasks. Overall, the implementation of the ADDIE model not only improved the quality of instruction but also created conditions for a deeper understanding of colour painting as an artistic discipline, crucial for professional development.

Keywords

professional training; teaching methods; student motivation; technology integration; ancient buildings.

1. Introduction

The theory and practice of instructional design in vocational education continues to evolve, resulting in the emergence of hundreds of instructional design models, most of which are interpretations and extensions of the Analysis, Design, Development, Implementation, Evaluation (ADDIE) model. The ADDIE model is a systematic approach to instructional design that guides educators through the entire process of creating effective learning experiences. The model consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The Analysis phase involves identifying the learners' needs, defining learning objectives, and understanding the context in which the learning will take place. This stage provides the foundation for all subsequent decisions regarding the course structure and content. The Design stage focuses on creating a detailed plan for the course, outlining the specific learning outcomes, instructional strategies, and assessment methods. It ensures that the teaching approach aligns with the identified needs of the learners. In the Development phase, the actual instructional materials are created based on the design plan. This can include creating course content, selecting teaching tools, and developing multimedia elements. The Implementation phase involves delivering the course to students, often requiring the adaptation of teaching materials and strategies based on real-time feedback and classroom dynamics. Finally, the Evaluation stage is essential for determining the effectiveness of the course, both during the process (formative evaluation) and after its completion (summative evaluation). This phase provides critical insights into whether the learning objectives have been met and what improvements might be needed for future iterations. The cyclical nature of the ADDIE model allows for continuous refinement and enhancement of the instructional design.

Several researchers have contributed to understanding how blended learning and structured instructional models can enhance student engagement, learning outcomes, and artistic skills development. Shahat et al. (2023) explored the use of the ADDIE model in fostering creativity in architectural education, particularly in synthesizing raw materials. While the focus was on creativity and material synthesis rather than colour painting in architectural contexts, their findings support the application of the ADDIE model in fostering creative problem-solving and engagement, which are important for teaching colour painting of ancient architecture. Their work emphasizes how structured learning approaches can enhance students' practical skills, which directly relates to the current study's goals of improving the integration of theory and practice. Huang (2024) examined the impact of the ADDIE model on contemporary cultural and creative product design, particularly using logistic regression to analyze educational outcomes. While this study focused on product design rather than architectural painting, it aligns with the current research by demonstrating how structured, model-based approaches in education can improve students' understanding of complex visual and artistic concepts. In the context of colour painting, this supports the hypothesis that digital tools and structured learning can enhance student understanding of the application of colour in architectural design.

Tjahyadi et al. (2023) applied the ADDIE model to corporate online learning, exploring how a systematic approach helps organize and enhance the learning process. While their research pertains to corporate education, the findings are relevant to vocational education, particularly in how the ADDIE model structures learning to increase motivation and skill development. Their conclusions are important for understanding how blended learning models, which combine online and offline components, can be applied effectively in the teaching of artistic subjects like colour painting. Zou et al. (2023) reviewed the use of Virtual Reality (VR) and Simulated Virtual Reality (SVVR) in language education within the framework of the ADDIE model. While the focus was on language education, the integration of VR as a learning tool is directly relevant to the current study's exploration of digital tools and simulations. The current research similarly aims to improve students' learning experiences by integrating modern technologies, such as virtual environments, to enhance their understanding of architectural structures and their colour representation.

Maxnun et al. (2024) focused on the development of cognitive assessment tools based on the ADDIE model, emphasizing the importance of structured assessment

in educational settings. This study is particularly useful for understanding how formative and summative assessments can be integrated into the course design for the "Colour Painting of Ancient Architecture" course. The application of structured assessments, as explored by Maxnun et al., is a crucial component of the current study, which seeks to improve how students' artistic skills and knowledge are evaluated through a blended learning approach. Rey et al. (2024) applied the ADDIE model to design e-learning modules for operating system concepts. Their study demonstrated how clear instructional structure and tailored content can enhance student performance in technical subjects. This aligns with the current research's focus on structuring the learning experience for art students, with the goal of improving the clarity and efficiency of instructional delivery in the "Colour Painting of Ancient Architecture" course.

Song and Sabran (2024) investigated the use of image resources in teaching based on the ADDIE model, highlighting the importance of visual materials in enhancing student engagement and understanding in art education. This directly relates to the current study's focus on colour painting, where visual resources such as architectural drawings and colour palettes are critical for student learning. Their findings underscore the value of integrating visual aids within a structured learning model to improve student understanding and creativity. Although these studies vary in their specific focus areas, they collectively emphasize the importance of structured, model-based learning, digital tools, and interactive resources in enhancing student engagement, motivation, and skill development. The current study builds on these findings by applying the ADDIE model specifically to the teaching of colour painting in ancient architecture, integrating both theoretical knowledge and practical skills with modern digital tools to improve student learning outcomes.

Research into this issue is essential for understanding the effectiveness of integrating digital tools into the learning process.

The research aimed to develop and implement the ADDIE model to enhance the effectiveness of the course "Colour Painting of Ancient Architecture" in vocational education by integrating theoretical and practical aspects of learning. The research objectives were:

1. To analyse the current state of teaching the "Colour Painting of Ancient Architecture" course and identify key challenges and strengths.
2. To design a blended learning model based on the ADDIE approach to integrate online and offline teaching methods.
3. To conduct a comparative analysis of the learning outcomes of students using the ADDIE model versus those taught with traditional methods.

2. Materials and methods

2.1. Research design

This study employed a methodology based on the ADDIE model to compare the effectiveness of new and traditional teaching methods in the "Colour Painting of Ancient Architecture" course. The research consisted of two main stages. The first stage involved examining the current skills, abilities, and knowledge of students enrolled in the "Colour Painting of Ancient Architecture" course. The second stage involved the implementation of the ADDIE model to develop and apply a hybrid curriculum based on the existing programme at the Henan Technical College of Construction. This model addressed the issues identified in the first stage, specifically by improving the integration of theory and practice, enhancing student motivation, and establishing clear assessment criteria.

2.2. Participants

The study included students from the Henan Technical College of Construction, which offers programmes in ancient architecture where blended design can be applied in teaching. The total number of participants was 100, with students aged between 18 and 22 years, second-year students of the "Ancient Architecture" curriculum. Participants in the study were divided into two groups: an experimental group that received instruction based on the ADDIE model and a control group that was taught using traditional methods. In the experimental group, students employed a blended approach that

combined online courses with offline seminars. During the design phase, educational materials were developed that integrated both theoretical and practical knowledge. These materials included textbooks and electronic resources on the theory of colour painting, covering the fundamentals of colour theory, painting techniques, and art history. Practical guides were also included, containing exercises designed to develop technical skills, as well as worksheets with assignments for independent study. Video lessons demonstrating painting processes and colour application were utilised, along with interactive platforms for sharing ideas and providing constructive feedback on peers' work, which enhanced material comprehension. Following this, the programme was implemented, featuring group projects, individual assignments, and practical sessions. The control group received instruction through traditional lecture methods, which did not facilitate interactive engagement or the use of modern technologies. Assessment of outcomes was conducted before the commencement of the course and at its conclusion, followed by a comparative analysis.

2.3. Assessment methods

The assessment methods employed in this study were designed to evaluate both the theoretical and practical progress of the students throughout the course. The level of knowledge was primarily measured through average current scores, which reflected students' understanding of the course material at both the beginning and end of the experiment. These scores provided a direct comparison between the control and experimental groups, allowing for an assessment of how effectively the blended learning approach contributed to knowledge acquisition. Another key criterion was the time taken to master the information. This was determined by self-reported data, where students indicated the amount of time they spent studying each week, including both independent study and participation in practical sessions. The time indicator offered insight into how efficiently students absorbed the material, providing a foundation for understanding the learning pace in each group. Finally, the level of critical thinking was assessed through tasks designed to evaluate students' ability to analyze, synthesize, and apply their knowledge to solve problems creatively. These tasks were integrated into both theoretical and practical components of the course, providing a measure of how well students could transfer their knowledge to real-world scenarios. This multi-faceted assessment approach ensured a comprehensive evaluation of students' progress in the colour painting of ancient architecture, highlighting both their cognitive development and practical skill acquisition.

3. Results

Colour painting of ancient architecture is an artistic practice that combines architectural knowledge with the aesthetics of colour and techniques for visually representing historical buildings. This course allows students to immerse themselves in the cultural heritage of various civilisations, studying not only architectural forms and styles but also how they were depicted using colour, light and shade, and perspective (Riznyk and Riznyk, 2024). As ancient architecture is a significant part of human history, its accurate colour rendering helps to better understand the aesthetics, symbolism, and functionality of buildings that existed centuries or millennia ago. Students learn to depict various materials used in ancient structures, using colour to convey textures, volumes, and details. Improving the teaching of this course is essential as it helps prepare students for the contemporary challenges in architecture and design. Traditional teaching methods often focus solely on technical aspects, neglecting the need for integrating modern technologies and individualised approaches to each student (Suranchiyeva et al., 2023). The use of blended learning, combining online resources and traditional face-to-face sessions, makes the course more accessible to students. This allows them not only to acquire theoretical knowledge but also to apply it practically in virtual environments, leading to a better understanding of architectural objects and their representation in colour. Enhancing the course fosters a deeper understanding of architectural history, develops artistic skills, and enables students to adapt their knowledge to contemporary projects, which is crucial for their professional development. Colour painting of ancient architecture also helps students

develop their imagination and creativity, as they not only reproduce well-known architectural objects but can also experiment with various artistic approaches. Studying this course promotes the ability to conduct in-depth analyses of form, proportion, and structure, which is essential in the field of contemporary architectural design. Additionally, students have the opportunity to learn more about the colour palettes used by architects in the past and how they influenced the perception of architectural objects in different historical periods.

Enhancing the teaching of this course is particularly relevant given that contemporary architectural education must align with technological advancements (Mysak and Mysak, 2024). The integration of blended learning allows for the use of modern digital tools to study and recreate ancient architectural objects, making the learning process more interactive and engaging. For instance, the use of virtual reality software enables students to explore ancient cities and investigate architecture in a three-dimensional space, significantly improving their perception and understanding of the structure and function of buildings (Ramankulov et al., 2015). By improving the teaching of colour painting of ancient architecture through modern approaches and technologies, students develop deep professional knowledge, broaden their perspective on architectural heritage, and are better equipped to adapt their acquired knowledge to the demands of contemporary architectural practice (Srybna, 2024).

Teaching colour painting of ancient architecture through a blended learning approach offers several key advantages that contribute to a more flexible, inclusive, and effective learning experience. One of the core features is the combination of online and offline learning modalities. This allows students to access theoretical information through digital resources such as video lectures, interactive presentations, virtual tours, and other online learning materials. These tools help students better grasp theoretical concepts, particularly in the context of studying the historical aspects of architecture, and provide access to additional knowledge resources (Derevyanko and Zalevska, 2023). The offline component of blended learning involves traditional classes where students apply their knowledge in practice by completing colour painting exercises of architectural objects. A crucial aspect of offline learning is the opportunity for face-to-face interaction with the instructor, facilitating a deeper understanding of the technical aspects of drawing and architecture. Furthermore, the blended design enables educators to adopt an individualised approach to the needs of each student, employing digital platforms to monitor progress and provide personalised feedback.

Another significant feature of blended learning in teaching colour rendering of ancient architecture is the use of interactive technologies to enhance student motivation. These technologies allow students to engage in virtual projects, create their own work using specialised architectural design and painting software, and collaborate with their peers. This enables students not only to receive feedback from their instructor but also to exchange ideas and experiences with their classmates, fostering critical thinking and teamwork skills. The blended learning approach also cultivates independence in students, as they can independently plan their learning process and spend more time on topics that require deeper understanding. This allows them to better develop their skills in the field of colour painting of ancient architecture, which is essential for their professional development (Zabolotska, 2023).

The colour painting of ancient architecture is a rather specialised subject, typically taught within broader programs in architecture, design, or art. In China and many other countries, this subject is included in the curricula of architecture faculties or art colleges. Teaching this subject through blended learning allows for the integration of modern technologies into the learning process, making it more flexible and accessible, particularly for students in remote regions. This approach broadens participation, stimulates interest in the subject, and enhances its appeal among young professionals in architecture and art. A crucial aspect was to determine the baseline data for both groups before the start of the experiment (Table 1).

Criteria	Results	
	Control group	Experimental group
Knowledge level based on average current grades	62% of the maximum possible score	61% of the maximum possible score
Average time to assimilate information	15 hours per week	15 hours per week
Average level of critical thinking	54% of the maximum possible level	55% of the maximum possible level
Level of practical skills	62% of the maximum possible score	61% of the maximum possible score
Level of student motivation	64% of the maximum possible level	63% of the maximum possible level

Table 1. Results of the study of all participants by three criteria at the beginning of the experiment. Source: compiled by the authors.

At the beginning of the study, all students completed a knowledge test on the course "Colour Painting of Ancient Architecture". The results indicated that students possessed a foundational understanding of the subject but did not have a complete grasp of all aspects of the material, thus providing opportunities for further development during the course. To determine their learning pace, students self-reported the amount of time they typically spent studying new material. According to the survey, both groups reported a similar average time spent on learning. This time included both independent study and attending lectures and completing practical assignments. This indicator suggests a moderate level of students' ability to apply their knowledge to solve creative and analytical problems, but with potential for improvement within the course. These data served as baseline measurements for comparison with the results after the completion of the course in the experimental and control groups.

The analysis of initial test scores demonstrated that both the control and experimental groups had comparable levels of theoretical knowledge and practical skills at the start of the study. Statistical verification confirmed that the differences in their performance were minimal, ensuring that the experiment was conducted under equal conditions. Another key factor in the evaluation was student motivation. The data indicated a moderate level of motivation in both groups, with most students expressing interest in the subject. However, not all participants showed a willingness to invest additional time in independent study. These findings provided a foundation for further analysis of how the implementation of the new instructional approach influenced engagement and learning outcomes over time. The level of practical skills and student motivation did not show significant changes after the developed course. While both aspects were carefully considered during the course design, the results indicate that the improvements in knowledge and critical thinking were more prominent, suggesting that the practical application of skills and overall student motivation remained relatively stable. This could be due to the fact that although the blended learning approach integrated new digital tools and interactive elements, the students' inherent motivation and hands-on skills development may require more targeted interventions or longer exposure to the newly designed curriculum for noticeable improvement.

The time students spent studying the material was a crucial indicator during the initial analysis. This allowed for the collection of data regarding the average time students spent mastering the material, which helped to understand how effectively they worked outside the classroom. The average time spent studying in both groups was 15 hours per week. This figure indicates that students allocated an equal amount of time to prepare for classes, which was important for comparing learning outcomes in the control and experimental groups. Students' critical thinking skills were assessed based on their ability to analyse information, apply it to solve creative problems, and find alternative solutions while completing practical tasks. To assess this, students were given several tasks where they had to demonstrate their ability to think critically and analyse various aspects of architectural drawings. The control group achieved a score of 54%, while the experimental group scored 55%. This indicated that, at the beginning of the study, students in both groups had a similar level of critical thinking. Further research aimed to assess how the ADDIE model could influence the development of this skill within the experimental group.

Stage	Description	Number of sessions	Types of projects	Assessment
Analysis	Determining students' starting level through an online survey and analysing course objectives	1 online session	-	Introductory survey and knowledge pre-test
Design	Developing the course structure. Creating combined sessions: online theory, studio practice	2 sessions (1 online, 1 offline)	-	Course discussion in the online community
Development	Creating multimedia resources (video tutorials, interactive tests). Preparing materials for studio work	-	3 individual online exercises	Platform-based feedback
Implementation	Conducting blended learning: 60% online theory (lectures, videos), 40% offline studio practice	12 sessions (6 online, 6 offline)	2 group projects (offline) and 3 individual online assignments	Formative assessment through portfolio
Evaluation	Online reports, student and instructor reflection. Final exhibition of student work in a blended format (online and offline)	1 concluding session	1 individual final project (offline)	Project defence (offline) + online presentation of work

Table 2. The main aspects of the enhanced colour painting curriculum. Source: compiled by the authors.

The initial assessment identified both key challenges and strengths in the approaches to teaching colour painting of ancient architecture using blended learning. A major issue was the insufficient integration of theoretical knowledge with practical tasks. Most students demonstrated a moderate level of theoretical knowledge, but they struggled to apply this knowledge in practice. This highlighted the need to strengthen the connection between theoretical lectures and practical sessions to ensure a deeper understanding of the material. Another problem was the lack of student motivation to delve deeper into the course. Although most students expressed interest in the topic, this interest did not always translate into active work outside of class or the completion of additional tasks. This indicated a need to change approaches to organising the learning process to make it more engaging for students. On the positive side, students were highly active during classes and showed a keen interest in practical tasks. The majority of students were eager to produce colour drawings and participate in creative assignments, suggesting that they derived enjoyment from the practical work involved.

Subsequently, the learning process in the study was organised by dividing participants into two main groups. The experimental group underwent training using the ADDIE model. This group employed a blended learning approach, combining online courses with offline seminars. This format allowed students to integrate the flexibility of online learning with the opportunity for discussion and collaboration during face-to-face meetings (Table 2).

The main online elements included recorded lectures on colour theory, video tutorials demonstrating various painting techniques, interactive quizzes on colour theory, and online discussions along with the exchange of artworks on the Moodle platform. Offline learning involved studio-based practical sessions where students learned about applying paint and created their own work, as well as group projects involving collaborative painting. The 3 individual online exercises in the Development stage were prototype tasks designed for students to engage with and provide feedback on the curriculum, rather than tasks for formal assessment. These exercises allowed students to test preliminary learning materials and offer insights for further refinement of the course content. At the end, a final exhibition was organised where students presented their work both physically and online (virtual gallery). Formative assessment was conducted during the Implementation and Evaluation stages, where students actively engaged with the content. During the Design and Development stages, the focus was on evaluating the curriculum, not student performance. The summative assessment consisted of an analysis of the final project and a defence of the work (offline) with a digital presentation (online).

The control group followed traditional teaching methods, which focused on lectures and passive learning. In this case, learning primarily involved the transmission of theoretical knowledge without significant interactivity or practical application. Students received information in lectures, and interaction with the instructor and other students was minimal. This approach did not involve the use of modern technologies or interactive elements, limiting opportunities for active student participation in the learning process. The main difference between the two groups was the teaching methods and approaches to student engagement with the material. The experimental group had access to modern teaching methods that promoted more active involvement in the learning process and better knowledge acquisition, while the control group relied on a traditional passive approach that did not encourage active participation and interaction. After that, the assessment of the students' abilities was repeated according to the key criteria (Table 3).

The results of the study revealed significant differences in learning effectiveness between the two approaches. The experimental group, which followed a blended learning approach, demonstrated a higher level of mastery of both theoretical and practical material. This was possible due to the combination of online courses, allowing for flexible self-directed learning, and offline seminars, which provided live interaction between students and the lecturer. This model facilitated greater

Criteria	Results	
	Control group	Experimental group
Knowledge level based on average current grades	68% of the maximum possible score	82% of the maximum possible score
Average time to assimilate information	14 hours per week	12 hours per week
Average level of critical thinking	60% of the maximum possible level	75% of the maximum possible level

Table 3. Results of the study of all participants by three criteria at the end of the experiment. Source: compiled by the authors

student engagement in the learning process and a deeper understanding of complex topics. Conversely, the control group, which used traditional lecture-based methods without interactive elements, demonstrated a more superficial understanding. The main reason for this is the lack of practical application of the material and limited opportunities for self-directed learning in an interactive environment. Control group students relied more heavily on theoretical lectures, which made it difficult for them to consolidate the material in practice. Students in the experimental group spent less time mastering the material compared to their counterparts in the control group. This can be attributed to the fact that the blended learning approach enabled better organisation of the learning process through access to online courses, where students could independently work on the material at their convenience. Additionally, the integration of theoretical knowledge with practical tasks significantly improved the memorisation and understanding of information. The control group, which followed traditional lecture-based methods, spent more time on independent study as students did not have access to interactive learning tools. They relied on their own lecture notes and textbooks, which required more time for comprehension and practice.

The experimental group also demonstrated a higher level of critical thinking development compared to the control group. This was a result of the emphasis on interactive teaching methods, including group projects and individual assignments. During these activities, students had the opportunity to analyse problem situations, seek innovative solutions, and apply their knowledge in practical contexts. They actively interacted with each other, discussed potential solutions, and employed creative approaches. Such activity significantly contributed to the development of analytical and synthetic skills, which are the foundation of critical thinking. In contrast, in the control group, the development of this aspect was limited due to the predominant use of theoretical lectures and the absence of practical assignments, which made it difficult to apply knowledge in real-world situations.

At the beginning of the study, the knowledge level of students in both groups was virtually identical. The control group had a slightly higher average score, but the difference was negligible, indicating a roughly equal starting level of student preparation. All study participants possessed basic knowledge, but their theoretical and practical skills were not yet fully developed. Regarding the time students spent mastering the material, at the beginning of the study, both groups spent the same amount of time studying. This indicates a level playing field in terms of workload prior to group division. All students, regardless of group, spent the same number of hours per week to learn new information. The initial level of critical thinking was also similar in both groups. Students had average scores in terms of their ability to analyse and solve complex problems. This suggests that they had the potential to develop their analytical skills, but at the beginning of the study, they did not demonstrate high performance in this area.

At the conclusion of the experiment, significant differences between the two groups became evident. The experimental group, which employed a blended learning approach, demonstrated a substantially higher level of knowledge compared to the control group. Students in the experimental group better grasped both the theoretical and practical aspects of the course due to the integration of online courses and offline seminars. This allowed them not only to study the material in a more convenient format but also to actively apply their knowledge in practice through group projects and individual assignments. The control group, which followed traditional lecture-based methods, also demonstrated improvements in knowledge, but their results were significantly lower as students did not have the opportunity to actively utilise their knowledge in an interactive format.

In terms of the time to assimilate information, the experimental group spent fewer hours studying towards the end of the course compared to the control group. This suggests that the blended learning approach was more effective in terms of organising the learning process. Students were able to better allocate their time between online tasks and offline seminars, allowing them to acquire new knowledge more quickly. In the control group, although the study time per week decreased compared to the beginning of the course, students still spent more time independently working on theoretical material, indicating a less effective acquisition of knowledge.

The research findings demonstrate that a blended learning approach, incorporating both online courses and offline seminars, was significantly more effective compared to traditional methods. Students in the experimental group not only achieved higher levels of knowledge and critical thinking but also spent less time mastering the material, indicating a better organisation of the learning process and the greater efficiency of interactive teaching methods. The application of a blended approach within the ADDIE model, combining online and offline learning elements, enabled students in the experimental group to achieve better results in both theoretical knowledge acquisition and critical thinking development. The control group also showed improvement, but their progress was less pronounced in all key aspects.

Based on the information obtained, it has been found that the application of the ADDIE model in professional education for the study of the colour painting of ancient architecture using a blended approach has both strengths and weaknesses. Among the strengths, a systematic approach can be highlighted, which provides a clear structure for the learning process. Each stage, from analysing student needs to evaluating results, allows for careful course planning, which is essential for complex disciplines such as the colour painting of architectural styles. The analysis stage enables the identification of specific student needs, allowing for tailoring the learning to their starting level and developing the necessary skills. For example, this approach helps to focus on specific aspects of painting that require more attention, such as drawing techniques or the study of historical styles. The ADDIE model facilitates the effective integration of theoretical knowledge with practical application. The blended approach, combining online courses and offline seminars, promotes better learning outcomes. Students can study the theory through online resources, which provides flexibility in the learning process, and then reinforce this knowledge in practical sessions (Altynbekova et al., 2024). This is particularly important in the study of painting, where theory and practice are closely intertwined. The flexibility of learning is another strength of the model, as students can independently organise their time for studying, which is crucial for those who are working or have other commitments. Additionally, the evaluation stage allows for continuous monitoring of student progress and making adjustments to the learning process to improve its effectiveness.

Furthermore, the ADDIE model also has certain limitations. Firstly, it requires a significant amount of time for preparation. Each stage, particularly the analysis and design of the course, can be very time-consuming, making it difficult to implement training programs quickly. This can be problematic when professional education requires rapid adaptation. Additionally, within the framework of blended learning, technical support becomes crucial. If there are no adequate educational platforms or stable internet access, this can create difficulties for students,

especially when working with visual materials, which are key to studying painting. Another challenge is student motivation. Despite the flexibility of blended learning, not all students can independently organise their online studies. A lack of appropriate discipline can lead to insufficient practical training. Furthermore, maintaining consistent feedback can be challenging due to the remote elements of learning. Lecturers may find it difficult to provide immediate feedback in real time, especially when it comes to artistic techniques that require constant correction and supervision. Finally, integrating traditional and digital tools is not always straightforward. Teaching practical skills such as drawing techniques or colour theory requires direct interaction with materials, which is difficult to achieve in a digital environment. Therefore, while the ADDIE model, combined with a blended approach, can be very effective for teaching the colour painting of ancient architecture, its success depends on the availability of technical support, student motivation, and the ability to provide continuous feedback throughout the learning process.

4. Discussion

The findings of this study demonstrate that blended learning is becoming increasingly popular in professional education, particularly in the fields of art and architecture. The application of the ADDIE model allows for the optimisation of the learning process, providing a structure that supports both the teacher and the student in an increasingly technology-driven environment. It has been found that advancements in technology and educational tools enable the teaching of colour painting of ancient architecture to become not only a theoretical but also a practical discipline, even in online or blended learning environments. The primary results of this research, which pertains to teaching the colour painting of ancient architecture using a blended model and the application of ADDIE, align with previous studies, namely A. Anggala et al. (2022). Most researchers agree that blended learning facilitates students' understanding of complex concepts through the combination of theoretical and practical aspects. For instance, studies by A. Spatioti et al. (2022) and A. Wahira and I. Tolla (2023) confirm that the use of online tools enhances student performance and increases their motivation to learn.

The research has demonstrated that the ADDIE model facilitates a structured approach to teaching painting, which in turn enhances student learning outcomes. It is well-established that blended learning enables educators to combine traditional teaching methods with online tools, fostering deeper understanding and the development of practical skills among students. Other researchers, such as R. Li and J. Sun (2024) and R. Rabiman et al. (2024) have also confirmed that blended learning, especially in the teaching of visual arts, significantly increases students' engagement with the material and allows them to acquire a more profound understanding.

The study by H. Meihami and A. Malmir (2024) focused on implementing blended learning in curricula with an emphasis on architectural painting. They found that this form of learning fosters a deeper understanding of complex architectural structures among students, particularly in reproducing their colour palettes. The blended approach provides students with access to additional visual materials, enhancing their ability to replicate intricate details. This research also highlighted the effectiveness of the ADDIE model, which provides a clear structure for the learning process. ADDIE enables the efficient organisation of teaching and assessment, helping to achieve similar results to those found in the studies of G. Yi (2024). This work focused on integrating deep learning into oil painting education, achieving high classification accuracy by combining color and brushstroke features. The findings also emphasized a personalized learning framework that improves student learning efficiency. Compared to the current study, which applies the ADDIE model to teaching colour painting of ancient architecture, Yi's research similarly demonstrates the effectiveness of structured approaches in enhancing learning outcomes. Both studies highlight the importance of tailored educational frameworks and the integration of modern technologies for improving student engagement and skill development.

The results of this study demonstrated that blended learning significantly increased student motivation,

particularly in interactive environments. These findings align with the research of M. Pratama et al. (2024), who investigated the impact of technology on student engagement. They discovered that digital tools, such as virtual lectures, interactive exercises, and digital simulations, enhance student involvement in the learning process. In the teaching of ancient architectural painting, this is particularly significant, as the use of virtual tours of historical sites and 3D visualisations allows students to directly interact with architectural objects (Brovko et al., 2024). The results of this study also indicated that students participating in blended learning reported greater satisfaction with the learning process. Their motivation levels increased compared to traditional teaching approaches.

The tailored instruction facilitated by the ADDIE model enabled a personalised approach for each student, which is particularly crucial in contemporary professional education (Kireyeva et al., 2019). As this research demonstrated, the ability to utilise online materials for review or supplementary study allows students to work at their own pace. Dam et al. (2024) investigated the use of Audio Augmented Reality (AAR) to enhance art gallery experiences. Their research demonstrated that incorporating interactive auditory elements into visual art exhibits significantly improved visitor engagement and understanding. This approach aligns with the findings of the current study, which also emphasizes the benefits of integrating modern technologies, specifically blended learning models incorporating self-directed study and access to supplementary materials, to enrich students' comprehension of ancient architectural colour painting. Both studies highlight that providing flexible, technology-enhanced learning environments can effectively increase student engagement and deepen understanding in art-related fields.

The research findings also indicated that the use of the ADDIE model enables more effective assessment of student learning outcomes, especially in practical disciplines such as architectural painting. This model is suitable for situations where not only theoretical knowledge but also practical artistic skills and a deep understanding of the learning material are essential (Buhaievskyi et al., 2023). The ADDIE model promotes a systematic approach to teaching and assessment, providing continuous feedback and allowing instructors to adjust the learning process based on actual student performance. The study of G. Lv et al. (2024) and J. Valencia et al. (2024) align with these findings, revealing that clearly structured assessment models, such as ADDIE, are particularly beneficial in blended learning environments that combine remote and face-to-face formats. With clear assessment criteria and regular feedback, students can better understand their strengths and weaknesses, leading to improved academic performance. It was found that the ADDIE model adds a clear structure to the learning process, allowing for easy evaluation of outcomes and making adjustments at each stage. This is supported by the research of R. Wang et al. (2024), who also emphasised the importance of assessment and feedback for effective learning in blended models.

This research supported this viewpoint. Through the use of the ADDIE model, it is possible to regularly monitor student progress, enabling timely adjustments to teaching materials and the provision of additional support. The feedback received by students helps them to refine their artistic skills, making the learning process more efficient and productive.

One of the primary advantages of blended learning is the utilisation of technology, which provides students with access to a vast array of learning materials (Shumka et al., 2020). This plays a crucial role in teaching colour painting, where a deep understanding of various styles and techniques is essential. By allowing students to view visual examples and complete practical tasks based on digital simulations, they are afforded more opportunities to enhance their skills (Rusho et al., 2024; Trofymchuk et al., 2022). The research demonstrated that students who had access to online resources, such as 3D visualisations of architectural objects, were able to not only better comprehend the principles of colour painting but also apply them in the practical context of architecture. Digital tools enable students to see real-world examples of colour used in different architectural styles and contexts, deepening their understanding and elevating their practical knowledge. Consistent with the aforementioned information, blended learning not only

broadens access to learning resources but also enhances the level of personalisation in the learning process, allowing students to learn at their own pace and gain more opportunities for practical improvement.

Therefore, the data from this study, combined with the findings of other researchers, confirms that blended learning using the ADDIE model is an effective tool for teaching the colour painting of architectural objects. The use of technology and a structured approach contributes to better student preparation and equips them with the necessary skills for professional development.

5. Conclusions

The ADDIE model was employed to enhance the course structure, define clear learning objectives, and develop assessment tools. This facilitated the integration of students' theoretical knowledge and practical skills, ultimately positively influencing their academic performance and motivation. Traditional methods primarily involved passive learning with an emphasis on theoretical knowledge, whereas the ADDIE model incorporated interactive and practical elements such as online courses, offline seminars, group projects, and individual assignments. This enabled active student engagement in the learning process, fostering the development of their creative thinking and problem-solving abilities.

Analysis of the results demonstrated that students who were taught using the ADDIE model achieved significantly higher results compared to those who employed traditional teaching methods. Improvements were observed in areas such as a deeper understanding of theoretical material, the development of practical painting skills, and the ability to think creatively. The blended approach, combining online and offline formats, provided greater flexibility in learning, allowing students to better adapt to the educational process. It is also important to note that the active participation of students in group projects and individual assignments contributed to the development of teamwork and responsibility, which are essential components of professional development.

The implementation of the ADDIE model also had a positive impact on student motivation and engagement with the subject matter. The use of modern technologies and blended learning approaches, including online courses, contributed to increased student activity, manifested in their greater participation in the learning process. This approach also enabled students to independently regulate their learning pace, enhancing their autonomy and accountability for their own outcomes.

The research has demonstrated that the ADDIE model is an effective approach to enhancing the quality of teaching disciplines such as colour painting in vocational education institutions. The model not only improved students' knowledge acquisition but also fostered their creative and analytical skills. A significant aspect is that the ADDIE model allows for the adaptation of educational methodologies to meet the contemporary demands of professional training, making it valuable for implementation in other areas of learning. Compared to traditional teaching methods, the blended learning model places a greater emphasis on increasing student engagement through the seamless integration of online and offline learning activities. It provides students with richer learning resources and more flexible learning methods. The model's comprehensive assessment mechanism can accurately reflect students' learning outcomes, providing valuable information for designing instruction in relevant courses such as engineering technology of ancient architecture. This contributes to a comprehensive improvement in the quality of teaching and learning outcomes.

One limitation of this study is the relatively small sample size, which was focused solely on students at Henan Technical College of Construction. This limits the generalisability of the findings to other educational institutions or specialisations. The future direction of this research lies in the further implementation of the ADDIE model in other disciplines and various educational institutions, which will allow for the collection of broader data on its effectiveness, the exploration of opportunities for integrating the latest technologies and innovations into the learning process, and specifically the development of more personalised learning pathways for students of different specialisations.

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