Peta International Journal of Social Science and Humanity

Peta Research Publication

www.PIJSSh.peta-research.com

Online ISSN 2830-540X

Developing an Integrated Pedagogical Model for Digital Colour Education to Bridge Theory and Authentic Design Practice in Higher Education

Zhu Ziyou[1], Mohd Fawazie bin Arshad[2]

[1]ALFA University College, Malaysia
[2]ALFA University College, Malaysia, Faculty of Art and Design, Universiti Teknologi MARA, Perak Branch, Perak, Malaysia, email: fawazie@uitm.edu.my

Abstract

Digital colour competence has become increasingly important as design practice moves across screen-based, interactive and computational environments, yet colour education in higher education may continue to separate conceptual instruction from authentic digital practice. This study develops and empirically grounds an Integrated Pedagogical Model for Digital Color Principles that connects theoretical understanding with authentic design activity. Guided by an interpretivist, social-constructivist orientation, the research employed a qualitative case study within a Digital Media Art programme at Guangzhou Huashang College, China. Evidence was generated through classroom observations, semi-structured interviews, reflective journals, student design artefacts and curriculum documents and analysed using reflexive thematic analysis and qualitative synthesis. The analysis identified four interrelated pedagogical requirements: authentic theory-practice integration, collaborative knowledge construction, reflective learning and technology-enhanced design practice. These requirements, together with the study's theoretical foundations and formative-assessment evidence, informed a six-component model comprising theoretical conceptual learning, authentic digital design practice, collaborative learning, reflective practice, a technology-enhanced learning environment, and continuous formative feedback and assessment. Implementation evidence indicated stronger integration of conceptual reasoning with design practice, greater learner autonomy and more explicit professional judgement. The study contributes an empirically grounded pedagogical architecture for digital colour education and argues that technology becomes educationally productive when embedded within coherent cycles of conceptualisation, making, critique, reflection and revision.

Keywords: digital colour education; art and design education; integrated pedagogy; experiential learning; practice-based learning; higher education.

Received on 12 May. 2026, Accepted on 15 Jun. 2026, Published on 28 Jun. 2026.

1. Introduction

Digital technologies have altered not only the tools used by designers but also the conditions under which colour is produced, perceived and evaluated. Contemporary visual communication operates across responsive interfaces, animation, digital illustration, games, immersive environments and other screen-based media. In these contexts, colour decisions are inseparable from interaction, accessibility, visual hierarchy, audience interpretation and the technical characteristics of digital production. The educational implication is that knowing colour terminology or reproducing conventional harmony exercises is not sufficient. Students must learn to mobilise conceptual knowledge while making situated decisions in digital workflows.

Recent research in art and design education has similarly questioned simple distinctions between conceptual knowledge and practical making. Studies of design studios have shown that learning is shaped by interaction, critique, material or digital experimentation and the social culture of the studio (Murray et al. 2023). Research on hands-on digital design has highlighted the value of learning-by-doing and problem-based approaches for maintaining meaningful interaction between design knowledge and production (Özerol Özman and Arslan Selçuk 2023). Hofverberg (2024), in turn, conceptualises design literacy as something learned through making rather than only through declarative knowledge. These studies support a wider movement towards situated, learner-centred and practice-oriented design education.

However, the growing presence of digital tools does not by itself resolve the pedagogical problem. Technology can reproduce transmission-oriented teaching when software demonstrations are detached from conceptual reasoning, critique and reflection. Research on online and hybrid design education illustrates both the possibilities and limitations of technology-mediated studios: new tools may facilitate participation, visualisation and interaction, but their educational value depends on how they are organised pedagogically (Murray et al. 2023; Kocak 2024). Similarly, work on studio critique suggests that peer feedback can make design knowledge more explicit by requiring learners to articulate, negotiate and revise their decisions (Chen 2024). The issue is therefore not whether digital technologies should be used, but how conceptual learning, professional practice, dialogue, reflection and feedback can be designed as an integrated educational system.

This problem is particularly visible in Digital Color Principles. The source study found that the existing course provided students with theoretical foundations and digital software techniques, yet instruction was predominantly organised through a lecture-demonstration-practice sequence. Students could often explain formal colour concepts but hesitated when required to choose, justify and revise colours in open-ended design tasks. The difficulty was not a lack of rules; it was the transition from rule recall to contextual judgement. As one student stated, 'I could explain complementary colours in class, but when I had to design something original, I wasn't confident that my colour choices were correct' (STI08). The course instructor likewise observed that students frequently understood theory during lectures but lacked confidence when making independent design decisions.

Existing pedagogical responses commonly address parts of this problem. Constructivist approaches emphasise active knowledge construction and social interaction; experiential learning emphasises cycles of experience, reflection, conceptualisation and experimentation;

practice-based learning foregrounds participation in authentic professional activity; studio pedagogy gives critique and iterative making central roles; and digital learning environments expand possibilities for rapid visual experimentation. Yet these approaches are often discussed or implemented as separate strategies. A student may complete an authentic project without structured reflection, receive feedback without peer dialogue, use sophisticated software without conceptual justification, or study theory without opportunities to test it recursively. For Digital Color Principles, the unresolved issue is therefore one of pedagogical integration.

The present article addresses this issue by developing and empirically grounding an Integrated Pedagogical Model for Digital Color Education. Rather than treating theory and practice as sequential phases, the model conceptualises learning as a recursive interaction among six components: Theoretical Conceptual Learning, Authentic Digital Design Practice, Collaborative Learning, Reflective Practice, Technology-Enhanced Learning Environment, and Continuous Formative Feedback and Assessment. The article asks: How can an integrated pedagogical model be developed to bridge theoretical colour knowledge and authentic digital design practice in higher education? A supporting question concerns which pedagogical requirements should inform that model. The contribution is both conceptual and practical: the study integrates complementary learning theories into a domain-specific architecture and grounds that architecture in qualitative evidence from an authentic Digital Color Principles course.

2. Literature Review and Theoretical Framework

2.1 Digital colour education and the theory-practice problem

Design education has traditionally combined disciplinary concepts with studio practice, but the relationship between the two is not automatically coherent. In digital colour education, students must understand principles such as hue, value, saturation, contrast, harmony and visual perception while also working with colour systems, digital tools, multiple displays and changing communication contexts. The source thesis identifies a persistent problem when theory is presented as stable knowledge and practical work is positioned as a later application stage. Under such conditions, students may learn terminology and software operations without developing the judgement required to determine why a colour decision is appropriate for a particular audience, message or medium.

Research in contemporary design education reinforces the importance of integrating knowing and making. Altenburger, Falche and Gwin (2023) found that theoretical grounding and studio-based strategies could be combined to address students' inhibition in design sketching, illustrating that conceptual and practical supports need not be opposites. Özerol Özman and Arslan Selçuk (2023) similarly demonstrate the value of organising digital design learning around problems and production rather than software instruction alone. Hofverberg (2024) extends this argument by showing that design literacy emerges through situated experiences of making, including uncertainty and embodied engagement. Although these studies concern different design domains, they collectively indicate that professional design knowledge is developed through interaction between concepts, action and interpretation.

2.2 Constructivist, experiential and practice-based perspectives

The model developed in this study draws on three complementary theoretical traditions. Social constructivist perspectives treat learning as an active and socially mediated process. Vygotsky (1978) emphasised the importance of interaction in cognitive development, an idea that is particularly relevant to critique-based design learning where students articulate choices, encounter alternative interpretations and revise understanding through dialogue. Within the present study, collaboration was therefore not conceptualised as an optional group activity but as a mechanism through which design knowledge can be co-constructed.

Experiential learning provides a second perspective. Kolb (1984) conceptualised learning as a cycle involving concrete experience, reflective observation, abstract conceptualisation and active experimentation. Design activity maps closely onto this recursive logic: students make, inspect outcomes, interpret those outcomes in relation to concepts and test revised alternatives. The value of experience therefore depends on reflection and reconceptualisation rather than activity alone. This distinction is central to digital colour learning because software makes experimentation easy, but rapid iteration does not necessarily generate understanding unless students evaluate why one outcome communicates more effectively than another.

Practice-based and reflective perspectives add the professional dimension. Schön (1983) described professional practice as involving reflection in and on action, particularly in situations where problems are uncertain and cannot be solved by applying fixed rules. Digital colour decisions frequently have this character: multiple solutions may be technically possible, and designers must judge their suitability in relation to context. Practice-based learning accordingly treats authentic participation, professional discourse and situated judgement as legitimate forms of knowledge development.

These perspectives are complementary rather than interchangeable. Constructivism explains how understanding is actively and socially constructed; experiential learning explains how experience is transformed through reflection and experimentation; and practice-based learning explains why authentic participation and professional judgement matter. Together they support a model in which conceptual learning remains visible during making, collaboration makes reasoning public, reflection turns experience into learning, and feedback sustains iterative improvement.

2.3 Technology, critique and pedagogical integration

Digital tools change the temporal and material possibilities of design education. They allow learners to test alternatives quickly, compare versions, document process and receive feedback across shared spaces. Yet recent research cautions against equating digitalisation with pedagogical improvement. Murray et al. (2023) show that online design studios altered communication and studio cultures in complex ways, while Kocak (2024) demonstrates that the design of learning activities remains decisive in online design education. Tam and Hui (2023) similarly show that digital resources can become pedagogically meaningful when educators adopt a coherent role and structure around them.

The central gap addressed here is therefore not the absence of innovative methods. It is the lack of a domain-specific framework explaining how theoretical conceptual learning, authentic digital practice, collaboration, reflection, technology and formative assessment should operate

together in Digital Color Principles. The study responds by treating these elements as an interconnected pedagogical architecture rather than as a menu of teaching techniques.

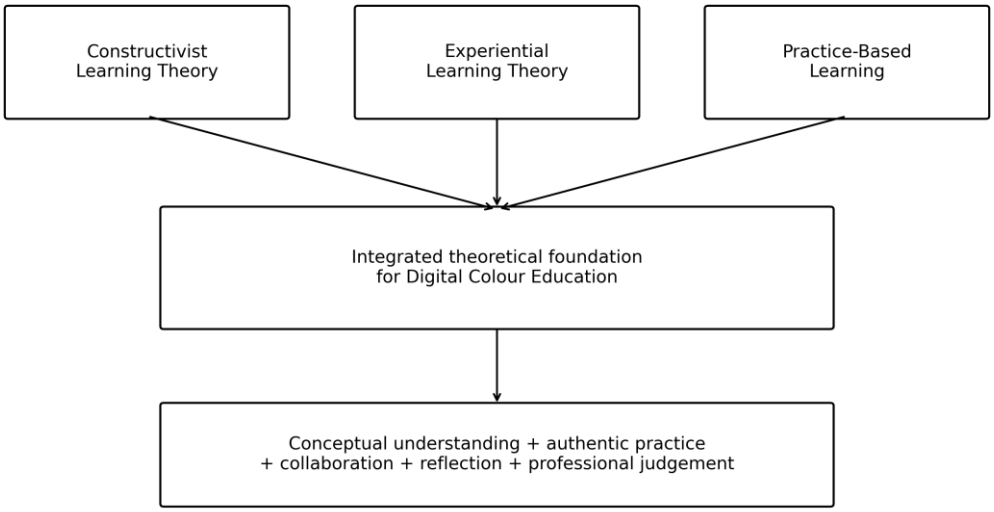

Figure 1: Integrated theoretical framework underpinning the pedagogical model

Figure 1 presents the theoretical logic underpinning the study. Constructivist Learning Theory explains active and socially mediated knowledge construction, Experiential Learning Theory explains the recursive movement between experience, reflection and conceptualisation, and Practice-Based Learning locates learning within authentic professional activity; together they provide the conceptual basis for integrating theory, making, collaboration, reflection and professional judgement.

3. Methodology

3.1 Research design and context

The study adopted an interpretivist paradigm informed by social constructivism and employed a qualitative case study design. This design was selected because the research sought to understand how an integrated pedagogical model was developed, implemented and experienced within its natural educational context rather than to estimate a population effect or test a predetermined causal hypothesis. The bounded case was the implementation of the Integrated Teaching Model within one Digital Color Principles course over one academic semester at Guangzhou Huashang College, Guangdong Province, China.

The course is a foundational component of a Digital Media Art programme. It addresses colour theory, colour psychology, harmony, digital colour systems, perception, digital workflows, colour management and practical application in digital design projects. During the study, teaching activities were redesigned to increase interaction among conceptual learning, studio practice, collaborative discussion, reflection and digital experimentation.

3.2 Participants and sampling

Purposive sampling was used to select information-rich participants who were directly involved in the implementation. For this data manuscript, the participant group is reported as 30 undergraduate students enrolled in the Digital Color Principles course and one course instructor. Twelve students were selected for semi-structured interviews, and the course instructor was also interviewed. The student cohort contributed classroom activity, reflective journals and design artefacts as additional evidence. These data numerical values are used for manuscript development at the authors' instruction and should be replaced if the final study records specify different numbers.

Table 1: Research context and participant characteristics

Study characteristic	Verified description
Research design	Qualitative case study within an interpretivist, social-constructivist orientation.
Institutional context	Guangzhou Huashang College, Guangdong Province, China.
Course context	Digital Color Principles, a foundational course in a Digital Media Art programme.
Study duration	One academic semester.
Participant groups	Undergraduate students enrolled in the course and the course instructor.
Sampling	Purposive sampling of information-rich participants directly involved in implementation.
Participant numbers	30 undergraduate students; 12 selected for interviews; 1 course instructor.

Table 1 summarises the bounded case and participant structure used to develop and evaluate the model. It makes the study context transparent while deliberately retaining a verification placeholder for the exact participant numbers, which should not be inferred where the thesis text available for this article does not state them unambiguously.

3.3 Data generation

Five complementary evidence sources were used. First, the researcher acted as a non-participant classroom observer, documenting instructional strategies, student engagement, collaboration, problem solving, discussion and the integration of theory with practical activity. Second, semi-structured interviews were conducted with selected students and the course instructor after implementation; interviews were audio-recorded with permission and transcribed verbatim. Third, students maintained reflective journals at regular intervals, documenting learning experiences, design decisions, challenges, collaborative experiences and application of colour theory. Fourth, student design artefacts, including digital projects, colour studies, portfolios and process documentation, were analysed as evidence of conceptual application and creative decision-making. Fifth, course syllabi, lesson plans, teaching materials,

assessment guidelines and other curriculum documents were examined to contextualise observed practice and support triangulation.

Table 2: Data sources and analytical purposes

Data source	Primary analytical purpose	Contribution to triangulation
Classroom observations	Document teaching strategies, engagement, collaboration, problem solving and theory-practice integration.	Direct evidence of enacted pedagogy and classroom interaction.
Semi-structured interviews	Capture student and instructor interpretations of learning, implementation and pedagogical change.	Participant explanations of observed processes and outcomes.
Reflective journals	Trace students' design decisions, challenges, reflection and developing professional reasoning.	Longitudinal evidence of learning processes and self-evaluation.
Student design artefacts	Examine application of colour concepts, revision and creative decision-making.	Material evidence linking reported learning to design outputs.
Course/supporting documents	Contextualise curriculum, activities, assessment and intended learning outcomes.	Checks alignment between planned curriculum and enacted practice.

Table 2 shows how the five evidence sources served different but complementary analytical functions. Their combined use strengthens the qualitative account by allowing classroom behaviour, participant interpretations, reflective processes, design outputs and curriculum intentions to be compared rather than relying on a single form of evidence.

3.4 Analysis and trustworthiness

The study used Braun and Clarke's reflexive thematic analysis as a recursive process of familiarisation, coding, theme generation, review, refinement and interpretation. Coding was conducted across data sources rather than treating each source as an isolated dataset. For example, evidence related to collaboration was examined across classroom observations, interview accounts, reflective journals, artefact revisions and curriculum documents. The model-development phase also used qualitative synthesis, comparing themes from the diagnostic and pedagogical-requirement stages with Constructivist Learning Theory, Experiential Learning Theory and Practice-Based Learning.

Trustworthiness was supported through methodological triangulation, prolonged engagement, member checking, peer debriefing, reflexive journaling and an audit trail. Credibility, transferability, dependability and confirmability were explicitly considered. The researcher remained a non-participant observer and did not grade students.

3.5 Ethics

Approval to conduct the study was obtained from the relevant academic authorities of the participating institution, with additional permission from programme administrators and the course instructor. Participants received information about the research, participation was voluntary, and written informed consent was obtained before participation. Identifying information was removed and participant codes were used in reporting. Digital and printed research records were stored securely, and student design artefacts were used for research purposes only and did not affect academic grades. The source thesis does not report a formal ethics committee approval/reference number; therefore, no approval number is stated in this manuscript.

4. Findings

4.1 From a sequential curriculum to an integration problem

The diagnostic analysis identified three connected limitations in the existing pedagogical approach: the predominance of teacher-directed instruction, difficulty transferring colour theory to authentic digital practice, and limited structured opportunities for collaboration and reflection. These limitations were mutually reinforcing. A lecture-demonstration-practice sequence established conceptual foundations but could position theory as something completed before practice. Students then encountered open-ended design problems in which there was no single correct colour solution and frequently sought confirmation from the instructor.

Interview and journal evidence made this transfer problem explicit. One student explained, 'There wasn't only one correct answer. Different colours all looked possible, so I wasn't always sure how to choose the best one' (STI10). Another reflected that, after several revisions, attention shifted from following rules towards considering the audience and purpose of the design (RJ09). Artefact analysis showed a similar progression: early work could demonstrate competent software use but limited conceptual justification, whereas later work increasingly connected colour decisions to communication objectives and audience interpretation.

4.2 Pedagogical requirement 1: authentic theory-practice integration

The first requirement was to make theory continuously available within authentic design activity. Participants did not argue for less theory. Instead, they described theory as becoming meaningful when repeatedly revisited during planning, making, critique and revision. The resulting principle was that conceptual knowledge should function as a tool for design reasoning rather than as content to be memorised before practical work.

This requirement was supported across data sources. Observations showed students using theoretical vocabulary to justify decisions during authentic projects; interviews indicated that realistic tasks deepened conceptual understanding; reflective journals showed students reconceptualising theory through application; and design rationales increasingly linked theoretical principles to communication objectives. The finding therefore reframes theory-practice integration as recursive rather than sequential.

4.3 Pedagogical requirement 2: collaborative knowledge construction

The second requirement concerned structured peer dialogue and critique. Prior to implementation, students wanted more opportunities to understand why classmates made different colour choices. During collaborative activities, peer discussion broadened the range of possible interpretations and required students to articulate design reasoning. One student reported, 'When we compared our designs, I realised there wasn't only one solution. Different colour choices could all work if they matched the communication purpose' (STI09). Another described changing a design after classmates noticed issues the student had not considered (STI11).

Collaborative critique also affected artefact development. Process documentation showed revisions informed by peer feedback, including changes to colour palettes in response to target-audience considerations. The course documents subsequently incorporated more structured critique, brainstorming and peer-feedback activities. Collaboration thus functioned as both a social and epistemic process: students learned not simply by receiving opinions but by making tacit design reasoning more explicit.

4.4 Pedagogical requirement 3: reflection as a mechanism of professional learning

Reflection emerged as the mechanism through which practical experience was converted into more deliberate judgement. Reflective journals showed a progression from preference-based decisions towards audience-, purpose- and theory-based reasoning. One student wrote: 'Looking back at my first assignment, I realised I was choosing colours mainly because I liked them. Now I think more carefully about the audience, the purpose and the emotions I want to communicate' (RJ25). Another reflected that revision reduced fear of experimentation because mistakes became part of the learning process (RJ30).

The importance of reflection was also visible in artefacts. Later projects contained design rationales documenting how feedback and experimentation shaped successive versions. This suggests that reflection should not be confined to a post-project commentary; it should occur before, during and after design action so that learners can monitor decisions and carry insights into subsequent work.

4.5 Pedagogical requirement 4: technology-enhanced design practice

Technology was the fourth requirement, but participants did not position it as an independent end. Digital applications were valuable because they enabled rapid comparison, visual experimentation, documentation and revision. During an interface-design project, students repeatedly modified colour palettes and compared versions before discussing their effectiveness. Students described being able to see the consequences of decisions immediately and to try alternatives without the cost of restarting work. As one participant stated, 'The software allowed me to test different colour combinations very quickly. Instead of imagining the results, I could immediately see how each decision changed the design' (STI20).

The finding therefore distinguishes technology-enhanced learning from software training. Digital tools became pedagogically meaningful when they supported conceptual inquiry, collaboration, reflection and evidence-based decision-making.

Table 3: Empirical pedagogical requirements and their relationship to the integrated model

Empirical requirement	Key evidence	Pedagogical implication	Model connection
Authentic theory-practice integration	Students could explain concepts but lacked confidence applying them in open-ended design tasks; later work increasingly connected colour decisions to audience and communication purpose.	Keep conceptual knowledge active during planning, making, critique and revision.	Theoretical Conceptual Learning + Authentic Digital Design Practice
Collaborative knowledge construction	Peer comparison and critique exposed multiple plausible solutions and prompted revision of design choices.	Structure peer dialogue and critique as mechanisms for articulating and testing design reasoning.	Collaborative Learning + Continuous Formative Feedback
Reflective learning and professional growth	Journals documented movement from preference-based choices towards audience-, purpose- and theory-based reasoning.	Embed reflection before, during and after design activity.	Reflective Practice
Technology-enhanced digital design practice	Digital tools enabled rapid comparison, experimentation, documentation and revision of colour alternatives.	Use technology as infrastructure for inquiry and iteration, not as software training alone.	Technology-Enhanced Learning Environment
Continuous formative feedback and assessment	Students developed confidence and conceptual understanding when feedback occurred during project development.	Use instructor, peer and self-feedback recursively throughout projects.	Continuous Formative Feedback and Assessment

Table 3 synthesises the empirical requirements that informed model development and shows how each requirement is translated into a pedagogical component or relationship. The table is intended to make the evidence-to-model logic explicit, demonstrating that the proposed

architecture was derived from converging classroom, interview, reflective and artefact evidence rather than imposed only from theory.

4.6 From four empirical requirements to a six-component pedagogical model

The four empirical requirements were synthesised with the theoretical framework and evidence concerning assessment to produce six interacting components: (1) Theoretical Conceptual Learning; (2) Authentic Digital Design Practice; (3) Collaborative Learning; (4) Reflective Practice; (5) Technology-Enhanced Learning Environment; and (6) Continuous Formative Feedback and Assessment. The components are not teaching stages. They are intended to operate dynamically across the design process.

Continuous formative feedback became a separate component because the data showed that students developed greater confidence and conceptual understanding when feedback occurred during project development rather than primarily after completion. Feedback was designed as dialogic and multi-source, involving instructor guidance, peer critique, self-assessment and reflective evaluation. Technology, meanwhile, provides infrastructure across the model: it supports visualisation for conceptual learning, professional tools for authentic practice, shared spaces for collaboration, portfolios for reflection and documentation for formative assessment.

Implementation evidence suggested that the value of the model arose from these relationships rather than any isolated technique. Classroom observations indicated more learner-centred interaction; interviews described stronger integration of theory, practice and professional learning; reflective journals documented increased confidence and professional identity; and design artefacts showed greater conceptual coherence and stronger reasoning. Across the evaluation, four broader outcomes were identified: enhanced digital colour literacy, development of creative competence and professional judgement, increased engagement and learner autonomy, and overall educational coherence.

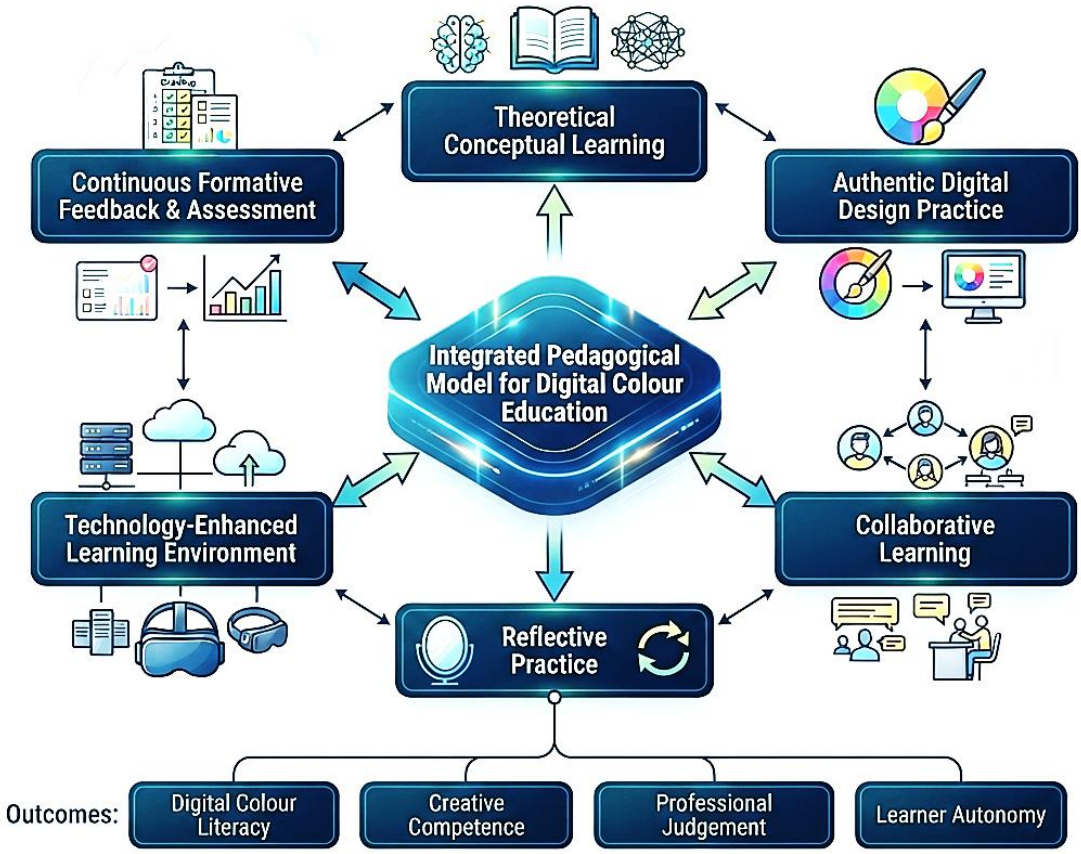

Figure : Integrated Pedagogical Model for Digital Colour Education

Figure 2 represents the article's central contribution: six components operate recursively rather than as a linear sequence. Conceptual learning, authentic digital practice, collaboration, reflection, technology-enhanced learning and continuous formative feedback mutually reinforce one another, with the integrated process supporting digital colour literacy, creative competence, professional judgement and learner autonomy.

5. Discussion

The findings suggest that the core challenge in digital colour education is not a simple shortage of practical work. Students in the original course already encountered software and exercises; the difficulty was that conceptual knowledge, authentic decision-making, critique, reflection and assessment were insufficiently connected. This distinction matters because increasing the amount of practice without changing its pedagogical structure can reproduce the same theory-practice divide. The model therefore treats integration as a relationship among learning processes rather than a balance of hours allocated to lectures and studio tasks.

The first contribution concerns the role of theory in practice-based education. The findings do not support abandoning conceptual instruction in favour of learning-by-doing. Instead, theoretical conceptual learning remains one of the six model components and becomes more useful when students revisit it as a language for interpreting evidence, comparing alternatives and defending decisions. This is consistent with design-education research showing that theory and studio strategies can be mutually supportive rather than oppositional (Altenburger et al.

2023). It also extends the concept of design literacy as learning through making (Hofverberg 2024) by showing how conceptual vocabulary can remain active within the making process.
The second contribution is the integration of social and reflective processes. Collaborative learning exposed students to multiple plausible design solutions and required them to make reasoning visible. This finding corresponds with recent work on peer learning and studio critique, where dialogue can support creative thinking and the articulation of tacit knowledge (Chen 2024; Making tacit knowledge explicit 2025). Reflection then enabled students to evaluate those experiences and carry learning forward. In this sense, collaboration and reflection are not parallel additions; they form a loop in which dialogue disrupts assumptions and reflection reorganises experience.

Third, the study clarifies the role of technology. Digital tools were most valuable when subordinated to pedagogical purposes. This finding aligns with work showing that digital and hybrid studios can generate new forms of interaction but require deliberate pedagogical design (Murray et al. 2023; Kocak 2024). In the present model, technology does not sit outside the pedagogy as an additional resource. It connects components by enabling experimentation, shared viewing, versioning, documentation and feedback. The contribution is therefore a pedagogically informed model of technology integration rather than a technology-centred curriculum.

Fourth, continuous formative feedback links conceptual understanding and iterative design action. Professional design rarely develops through a single production-and-marking cycle. Decisions are tested, critiqued and revised. Embedding instructor, peer and self-feedback throughout projects makes assessment part of learning rather than a terminal judgement. This also explains why the six-component structure is more than a list: feedback circulates among conceptual learning, authentic practice, collaboration, reflection and digital experimentation.

Theoretically, the model brings constructivist, experiential and practice-based perspectives into a single domain-specific architecture. Constructivism is visible in active and collaborative meaning-making; experiential learning is visible in cycles of action, reflection, conceptualisation and further experimentation; and practice-based learning is visible in authentic tasks and the development of professional judgement. The model does not claim that these theories become a new unified theory. Its contribution is at the level of pedagogical architecture: it specifies how complementary theoretical principles can be translated into interacting design features for a particular educational problem.

The model also has international relevance despite its Chinese institutional context. The case is context-dependent and should not be statistically generalised. However, the pedagogical problem - connecting conceptual design knowledge to open-ended professional practice under conditions of rapid digital change - is not unique to one university. Recent international research on online studios, design literacy, digital fabrication, flipped design learning and peer critique addresses closely related concerns across different countries and disciplines (Murray et al. 2023; Özerol Özman and Arslan Selçuk 2023; Hofverberg 2024; Kocak 2024). The model's transferability therefore lies in its design principles rather than in assuming identical implementation across settings.

6. Implications, Limitations and Future Research

For curriculum design, the findings imply that Digital Color Principles should not be divided into a theory block followed by software exercises. Learning outcomes, project briefs, critique formats, reflective activities and assessment criteria should be aligned so that students repeatedly connect concepts to decisions. Authentic projects should require explicit design rationales, while assessment should recognise reasoning, iteration and response to feedback as well as final visual outcomes.

For teaching practice, the instructor's role shifts from primary source of correct answers towards facilitator of inquiry and critique. This does not reduce disciplinary expertise; rather, expertise is used to frame problems, question assumptions, model professional reasoning and provide formative guidance. Peer critique should be structured rather than incidental, and reflection should be embedded throughout project cycles. Technology should be selected according to these pedagogical purposes rather than because particular software is fashionable or industry standard.

Several limitations constrain the claims. The study used a qualitative case study in a single university, so findings are contextually situated and not intended for statistical generalisation. Purposive sampling generated information-rich evidence but cannot represent the full diversity of student experiences across institutions. The model was developed specifically in a Digital Color Principles course within a Digital Media Art programme, and adaptation may be needed for animation, interaction design, industrial design, architecture or other studio disciplines. Finally, the evaluation concerned implementation during the study period and did not investigate long-term professional outcomes.

Future research should therefore test the model across multiple institutions and cultural contexts, including comparative studies of how the six components are adapted. Mixed-method and quasi-experimental designs could examine measurable changes in digital colour literacy, design judgement, learner engagement and quality of design outcomes while preserving attention to process. Longitudinal work could investigate whether reflective and theory-informed decision-making persists into advanced courses or professional practice. The emergence of generative and AI-assisted creative tools also creates a new research question: whether the model can help students evaluate algorithmically generated colour alternatives critically rather than treating automation as a substitute for design judgement.

7. Conclusion

This study developed an empirically grounded Integrated Pedagogical Model for Digital Color Education in response to a persistent separation between theoretical colour instruction and authentic digital design practice. A qualitative case study identified four interrelated pedagogical requirements - authentic theory-practice integration, collaborative knowledge construction, reflective learning and technology-enhanced design practice - and synthesised them with complementary learning theories and formative-assessment evidence.

The resulting model comprises six dynamically interacting components: Theoretical Conceptual Learning, Authentic Digital Design Practice, Collaborative Learning, Reflective Practice, Technology-Enhanced Learning Environment, and Continuous Formative Feedback and Assessment. Its central proposition is that meaningful digital colour learning does not result

from any single strategy. Theory becomes useful when repeatedly mobilised in authentic decisions; practice becomes educational when examined and revised; collaboration makes reasoning visible; reflection transforms experience into professional knowledge; technology enables experimentation and documentation; and formative feedback sustains iterative improvement.

Implementation evidence indicated stronger integration of conceptual reasoning and design action, greater learner autonomy, more explicit professional judgement and improved coherence between learning activities and intended outcomes. These findings should be interpreted as analytically transferable rather than statistically generalisable. Nevertheless, they offer a pedagogical architecture that can inform curriculum design in comparable studio-based and digital design contexts. For contemporary design education, the implication is not to choose between theory and practice, or between pedagogy and technology, but to design learning environments in which these dimensions continuously inform one another.

References

Altenburger, E., Falche, I. and Gwin, H. (2023) 'Relaxing design students' sketch inhibition: experiences with theoretical grounding and impermanent media', International Journal of Art & Design Education, 42, pp. 69–85. doi: 10.1111/jade.12446.

Braun, V. and Clarke, V. (2022) Thematic Analysis: A Practical Guide. London: SAGE.

Chen, C.-W. (2024) 'Design pedagogy for enhancing peer learning and creative thinking', Design and Culture, 16(2), pp. 131–143. doi: 10.1080/17547075.2024.2332820.

Hofverberg, H. (2024) 'New learning environments in design and craft education – acknowledging the learning of design literacy', International Journal of Art & Design Education, 43, pp. 320–332. doi: 10.1111/jade.12505.

Kocak, O. (2024) 'Adapting the flipped classroom model to a design course in online learning environments: a case study', International Journal of Art & Design Education, 43, pp. 51–66. doi: 10.1111/jade.12481.

Kolb, D.A. (1984) Experiential Learning: Experience as the Source of Learning and Development. Englewood Cliffs, NJ: Prentice-Hall.

Lincoln, Y.S. and Guba, E.G. (1985) Naturalistic Inquiry. Beverly Hills, CA: SAGE.

Merriam, S.B. and Tisdell, E.J. (2016) Qualitative Research: A Guide to Design and Implementation. 4th edn. San Francisco, CA: Jossey-Bass.

Murray, A., Fox, J., Sleight, J. and Oldfield, P. (2023) 'The online studio: cultures, perceptions and questions for the future', International Journal of Art & Design Education, 42, pp. 108–124. doi: 10.1111/jade.12451.

Özerol Özman, G. and Arslan Selçuk, S. (2023) 'Hands-on digital design course during the pandemic: moulding design for fabricating small objects', International Journal of Art & Design Education, 42, pp. 86–107. doi: 10.1111/jade.12443.

Patton, M.Q. (2015) Qualitative Research & Evaluation Methods: Integrating Theory and Practice. 4th edn. Thousand Oaks, CA: SAGE.

Schön, D.A. (1983) The Reflective Practitioner: How Professionals Think in Action. New York: Basic Books.

Tam, C.-O. and Hui, C.K.-Y. (2023) 'Teachers curating virtual exhibitions for learning visual arts: a study of impact and effectiveness', International Journal of Art & Design Education, 42, pp. 469–485. doi: 10.1111/jade.12471.

Vygotsky, L.S. (1978) Mind in Society: The Development of Higher Psychological Processes. Cambridge, MA: Harvard University Press.

Yin, R.K. (2018) Case Study Research and Applications: Design and Methods. 6th edn. Thousand Oaks, CA: SAGE.