

The Effects of an AI-Supported Illustration Design Learning System on University Students' Achievement and Motivation

Xi Zhang ¹, Kien Tsong Chau ^{1*}, Wan Ahmad Jaafar Wan Yahaya ¹

¹ Centre for Instructional Technology and Multimedia, Universiti Sains Malaysia, Penang, Malaysia

Xi Zhang: zhangxii@student.usm.my

Kien Tsong Chau: Corresponding Author: kientsongchau@usm.my

Wan Ahmad Jaafar Wan Yahaya: wajwy@usm.my

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ABSTRACT:

This study investigated the effects of an AI-Supported Illustration Learning System (AILS) on university students' learning achievement and motivation in illustration design. The study was motivated by the limited support for immediate and personalised feedback in conventional learning systems (CLS), which may limit students' learning achievement in illustration design. A quasi-experimental design was adopted, with learning mode (AILS versus CLS) serving as the independent variable and learning achievement and motivation as the dependent variables. A total of 60 undergraduate students from a university in China participated in the study. ANCOVA was conducted to examine differences in learning achievement, while an independent-samples t-test was used to compare motivation between the two groups. The findings revealed that students who learned through AILS achieved significantly higher learning achievement and reported higher motivation than those who learned through CLS. Overall, the findings suggest that AILS can enhance students' learning achievement and motivation in illustration design education.

Keywords: Artificial Intelligence, Illustration Design Education, Learning Achievement, Motivation

Introduction

The rapid advancement of artificial intelligence (AI) has reshaped educational practices, particularly within higher education, drawing increasing attention to its potential value in teaching and learning (Challoumis, 2024). With the growing availability of AI-powered tools, the integration of these technologies into educational practices has become increasingly widespread (Crompton & Burke, 2023). In 2023, the United Nations Educational, Scientific and Cultural Organisation published Guidance for Generative

AI in Education and Research, emphasising the significant role AI plays in enhancing learning quality, enriching educational resources, and advancing educational equity (Miao & Holmes, 2023). Higher education, given its demands for more complex knowledge structures and flexible learning support, provides a relevant context for the application of AI technologies (Qian et al., 2025). However, while AI has been increasingly applied across diverse educational contexts (Chen et al., 2020), its integration within art and design education remains relatively limited, with

research concentrated in other subject areas (Crompton & Burke, 2023; Zawacki-Richter et al., 2019). In this context, a thorough understanding of the characteristics of the target discipline and its key learning outcomes is essential when integrating AI into educational practice.

Learning environments that fail to sustain students' interest and engagement may negatively affect their willingness to participate in learning activities, which can in turn reduce learning performance (Tang et al., 2022). Motivation represents learners' sustained willingness to engage with and invest effort in the learning process, and is generally described through four conditions: attention, relevance, confidence, and satisfaction (Keller, 1987). As learner motivation is closely influenced by the learning environment, appropriate motivational support should be considered when developing AI-supported learning systems.

This concern is particularly relevant to illustration design education. As a core practice-oriented discipline within higher art and design education, illustration design has long emphasised hands-on creative practice rather than purely theoretical instruction (Fleischmann, 2025). Illustration design learning involves ongoing practice, during which immediate feedback from instructors can support students' improvement (Sawyer, 2017). However, constrained by large class sizes and limited faculty resources, instructors frequently struggle to provide immediate and personalised guidance to each student during the creative process (Bernacki et al., 2021; Winstone & Carless, 2020). Therefore, exploring the application of AI-supported learning systems in illustration design education may offer valuable insights into how such systems can better support students' learning achievement and motivation.

Research Questions

The key issues that this study aims to address are as follows:

1. Does the use of AILS enhance university students' learning achievement in comparison to CLS?

2. Does the use of AILS enhance university students' motivation compared with CLS?

Literature Review

AI in Education

AI-supported learning systems have been developed across disciplines to analyse learner-produced work and provide corresponding feedback (Anderson et al., 1995; Graesser et al., 2004; Deeva et al., 2021). More recent systems have adopted machine learning and large language models to generate personalised feedback without hand-crafted rules. For example, a randomised controlled trial found that learners receiving adaptive feedback generated by a large language model produced longer texts and performed better than those receiving static expert-written feedback (Kinder et al., 2025). Meta-analyses further confirm positive effects of AI feedback on learners' writing performance and self-regulated learning across multiple disciplines (Ngo et al., 2024; Huang et al., 2026). As an emerging instructional approach, AI-supported learning systems have demonstrated considerable potential in enhancing student learning across educational contexts.

AI in Art and Design Education

AI is an emerging area of research in art and design education (Zeng et al., 2026). Hwang and Wu (2025) reported the use of Midjourney and DALL-E in a design history course, where learners produced posters depicting European design movements, concluding that AI-supported design education calls for educational goals and methods that differ from those of conventional practice. Liu et al. (2025) evaluated Stable Diffusion and Midjourney in interior design education, with both tools considered more feasible than conventional methods for supporting creative exploration. In product design education, AIGC has been integrated into ideation teaching to support students' creative thinking and conceptual development (Huang et al., 2024). A systematic review of 78 studies on AI in fine arts education confirmed that visual images accounted for over half of the studies reviewed, indicating strong research interest in AI

applications within the visual arts domain (Zeng et al., 2026). These findings indicate that AI can effectively support student learning in art and design courses.

Achievement and Motivation

AI-supported adaptive learning systems have been shown to produce meaningful gains in learner achievement when learning is tailored to individual needs (Wang et al., 2024). Previous research has shown that effective feedback enables learners to recognise the gap between their current performance and the expected standard, thereby improving learning outcomes (Hattie & Timperley, 2007). For instance, Meyer et al. (2024) found that students receiving AI-generated feedback achieved significantly higher revision performance than those who revised without feedback.

Motivation refers to the internal processes that instigate and sustain goal-directed activities, functioning as a personal driver of choice, effort, persistence, and achievement across learning contexts (Schunk & DiBenedetto, 2020). The ARCS model conceptualises motivation along four dimensions: attention, relevance, confidence, and satisfaction (Keller, 2010). A meta-analysis of controlled experimental studies reported that ARCS-based design exerts a significant positive effect on both learner motivation and achievement, with higher education populations and technology-mediated learning environments producing particularly notable effect sizes (Goksu & Islam Bolat, 2021). A more recent meta-analysis focused on AI-supported personalised feedback reported a strong positive effect on learners' motivation, with an average effect size that exceeds the effect on learning outcomes themselves (Wang et al., 2026).

Experiment design

This study employed a quasi-experimental research design. One class was assigned to the experimental group and learned using AILS; the other class was assigned to the control group and learned using CLS. Notably, both groups were taught by the same instructor with over ten years

of experience teaching illustration design courses to ensure consistency in the teaching process.

Experiment participants

The participants in this study were two first-year undergraduate classes majoring in art and design at a university in Guangzhou, China. There were a total of 60 students in the two classes. None of the students had prior knowledge of illustration design.

Experiment instruments

Researcher-developed pre-tests and post-tests were used to assess participants' learning achievement, with each test lasting 20 minutes. The pre-test was administered two weeks before the treatment and the post-test after the treatment. The test consisted of twenty multiple-choice questions covering five illustration styles: flat, cartoon, hand-drawn, gradient, and 2.5D. Each style was assessed through four questions covering four dimensions: line, pattern, colour, and application.

The Instructional Materials Motivation Survey (IMMS) was used to measure participants' motivation after the treatment. The IMMS used in this study was developed based on the ARCS model of motivational design (Keller, 2010). The 36-item IMMS took 15 minutes to complete. The items were divided into four dimensions: attention comprising twelve items, relevance nine items, confidence nine items, and satisfaction six items. Each item was rated on a five-point scale ranging from 1 (not true) to 5 (very true) to measure students' motivation towards the learning system.

Experiment procedures

The intervention lasted seven weeks. In the first week, the researcher arranged an orientation session and system demonstration for all participants. Participants were introduced to the learning activities and informed that they could pause or withdraw from the study at any time. A preparatory lecture on illustration design styles, their historical background, and application was then delivered. The researcher explained how to operate the experimental system, after which

each participant was provided with a PC and given twenty minutes to practise using the system to mitigate possible novelty effects. For the next five weeks, both groups followed the same learning schedule, completing five units corresponding to five illustration styles. The experimental group learned using AILS, which analyses students' uploaded works against the target illustration style and provides immediate feedback through repeated practice. The control group learned using CLS, a conventional multimedia learning system without AI-supported components, and received feedback from the lecturer. During each unit, students created illustrations and uploaded their work for review and reinforcement. If participants encountered problems beyond the planned feedback, the researcher only explained permitted operations without providing additional learning guidance to avoid potential research bias. After the intervention, both groups completed the post-test assessment of learning achievement and the motivation survey.

Data Analysis

The collected data were analysed using SPSS. The analysis examined the effects of AILS on students' learning achievement and motivation. ANCOVA and t-tests were used to examine differences between the two treatment groups (Nordstokke & Zumbo, 2010).

Descriptive and inferential statistics were employed. ANCOVA was used to examine differences in learning achievement between the two groups after controlling for pre-test scores. An independent-samples t-test was used to compare motivation between the two groups.

Results

Results for RQ1: Effect on learning achievement

To examine the effect of AILS on students' learning achievement, a one-way analysis of covariance (ANCOVA) was conducted. Post-test achievement scores were used as the dependent variable, learning mode (AILS vs. CLS) as the independent variable, and pre-test achievement scores as the covariate. The assumption of homogeneity of regression slopes was met ($F =$

1.42, $p > .05$), indicating that ANCOVA was appropriate for the analysis. After controlling for pre-test scores, a significant difference was found between the two groups in learning achievement ($F = 18.67$, $p < .001$, $\eta^2 = .25$). Students using AILS achieved higher post-test scores than those using CLS. The results are presented in Table 1.

Table 1. The ANCOVA result of the two groups' achievement

Group	N	Mean	SD	F	η^2
Experimental Group	30	16.47	2.18	18.67*	.25
Control Group	30	13.83	2.54		

* $p < .001$

Results for RQ2: Effect on motivation

To answer research question 2, an independent-samples t-test was conducted to compare students' motivation between the experimental and control groups. The results showed a statistically significant difference in motivation between the two groups ($t = 2.71$, $p < .01$, $d = .70$). Students using AILS reported higher motivation than those using CLS, indicating that the AI-supported learning system had a positive effect on students' motivation. The results are presented in Table 2.

Table 2. The t-test result of the two groups' motivation

Group	N	Mean	SD	t	d
Experimental Group	30	4.08	0.51	2.71*	.70
Control Group	30	3.72	0.52		

* $p < .01$

Discussion

Discussion on the results of RQ1

The findings of this study regarding the effect on achievement are consistent with prior research confirming the learning benefits of AI-supported

learning systems. When AI-supported learning systems are used effectively, they can enhance students' learning engagement and thus improve their academic achievement (Wang et al., 2024). AI-supported feedback has been examined across areas such as language learning, programming, and medical education (Deeva et al., 2021). In contrast, research on AI-supported learning systems in art and design education remains limited, especially in illustration design courses in China. The integration of AI-supported immediate feedback through AILS provides a more responsive learning environment, enabling students to identify the gap between their current work and the target illustration style during the creative process. This finding is consistent with Hattie and Timperley (2007), who highlighted the effectiveness of feedback in facilitating the connection between current performance and expected standards. AI-supported learning, within the framework of constructivist learning theory, provides students with the opportunity to actively engage in illustration design practice, receive immediate feedback, and revise their work accordingly (Jonassen, 1999).

Discussion on the results of RQ2

The findings showed that students learning illustration design using AILS had significantly higher motivation than those using CLS. Numerous studies have shown that well-designed technology-enhanced learning environments can enhance student motivation (Goksu & Islam Bolat, 2021). Similar benefits have been reported for AI-supported learning environments compared with conventional learning approaches (Wang et al., 2026). Furthermore, the ARCS model suggests that when a learning system captures students' attention, presents relevant learning tasks, builds confidence through achievable goals, and provides satisfaction through meaningful feedback, learners are more likely to sustain their engagement (Keller, 1987). The immediate and personalised feedback provided by AILS may have contributed to students' sense of confidence and satisfaction, as they were able to monitor their progress and observe improvement in their illustration work throughout the learning process.

Limitations

This study has several limitations regarding the generalisability of its findings.

Firstly, this study is limited to art and design students learning illustration design at a university in Guangzhou. Thus, the generalisability of the findings to other disciplines, such as mathematics, history, medicine, and engineering, may be limited.

Secondly, the study's age range was restricted to university students aged 18 to 20. Due to the narrow age range, the findings may not be entirely applicable to younger or older students.

Significance of the Research

Firstly, this study develops a prototype of an AI-supported illustration design learning system that provides immediate feedback during the creative process, offering a new approach to illustration design learning among university students in China.

Secondly, by integrating AI technology into illustration design learning, this study demonstrates the feasibility of applying AI-supported learning in art and design education and provides insights for educators and policymakers.

Thirdly, this study provides empirical evidence of the effects of AI-supported learning on students' learning achievement and motivation in illustration design education.

Implications of the Research

Implications for Future Research

Future research could explore the application of AI-supported learning across different art and design subjects and age groups, as well as examine how specific features of AILS affect different students. Longitudinal or mixed-method studies could also provide further insights into its effects on learning achievement and motivation over time.

Recommendations for Future Research

Firstly, future research could develop and examine AI-supported learning applications in other art and design disciplines.

Secondly, as this study did not employ formal qualitative methods, future studies could use observations or interviews to explore students' experiences with the two learning systems.

Thirdly, the study could be replicated with larger samples across different locations, as the current sample was limited to 60 students from one university in Guangzhou.

Conclusion

Overall, this study developed AILS to support illustration design learning through AI-supported feedback. The findings indicate that AILS can improve students' learning achievement and motivation, providing a more responsive and interactive learning environment for illustration design education.

References

- Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences*, 4(2), 167–207. https://doi.org/10.1207/s15327809jls0402_2
- Bernacki, M. L., Greene, M. J., & Lobczowski, N. G. (2021). A systematic review of research on personalized learning: Personalized by whom, to what, how, and for what purpose(s)? *Educational Psychology Review*, 33(4), 1675–1715. <https://doi.org/10.1007/s11611-1618-01611-1618>
- Challoumis, C. (2024). Building a sustainable economy: How AI can optimize resource allocation. In *Proceedings of the XVI International Scientific and Practical Conference* (pp. 190–224). World of Conferences. <https://doi.org/10.5281/zenodo.13929032>
- Chen, X., Xie, H., Zou, D., & Hwang, G.-J. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers and Education: Artificial Intelligence*, 1, Article 100002. <https://doi.org/10.1016/j.caeai.2020.100002>
- Crompton, H., & Burke, D. (2023). Artificial intelligence in higher education: The state of the field. *International Journal of Educational Technology in Higher Education*, 20(1), Article 22. <https://doi.org/10.1186/s41611-1618-01611-1618>
- Deeva, G., Bogdanova, D., Serral, E., Snoeck, M., & De Weerd, J. (2021). A review of automated feedback systems for learners: Classification framework, challenges and opportunities. *Computers & Education*, 162, Article 104094. <https://doi.org/10.1016/j.compedu.2020.104094>
- Fleischmann, K. (2025). Making tacit knowledge explicit: The case for online peer feedback in the studio critique. *International Journal of Technology and Design Education*, 35(2), 699–721. <https://doi.org/10.1007/s11611-1618-01611-1618>
- Goksu, I., & Islam Bolat, Y. (2021). Does the ARCS motivational model affect students' achievement and motivation? A meta-analysis. *Review of Education*, 9(1), 27–52. <https://doi.org/10.1002/rev3.3231>
- Graesser, A. C., Lu, S., Jackson, G. T., Mitchell, H. H., Ventura, M., Olney, A., & Louwerse, M. M. (2004). AutoTutor: A tutor with dialogue in natural language. *Behavior Research Methods, Instruments, & Computers*, 36(2), 180–192. <https://doi.org/10.3758/BF03195563>
- Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81–112. <https://doi.org/10.3102/003465430298487>

- Huang, C.-Q., Lu, L.-N., Huang, Q.-H., Zhang, Y.-R., He, T., Tu, Y.-F., & Hwang, G.-J. (2026). Effects of artificial intelligence feedback on students' self-regulated learning in higher education: A three-level meta-analysis. *Educational Psychology Review*, 38, Article 64. <https://doi.org/10.1007/s11611-1618-10166-z>
- Hwang, Y., & Wu, Y. (2025). Graphic design education in the era of text-to-image generation: Transitioning to contents creator. *International Journal of Art & Design Education*, 44(1), 239–253. <https://doi.org/10.1111/jade.12558>
- Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2, pp. 215–239). Lawrence Erlbaum Associates.
- Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development*, 10(3), 2–10. <https://doi.org/10.1007/BF02905780>
- Keller, J. M. (2010). Motivational design for learning and performance: *The ARCS model approach*. Springer. <https://doi.org/10.1007/1611-1618-1611-1618-3>
- Kinder, A., Briese, F. J., Jacobs, M., Dern, N., Glodny, N., Jacobs, S., & Leßmann, S. (2025). Effects of adaptive feedback generated by a large language model: A case study in teacher education. *Computers and Education: Artificial Intelligence*, 8, Article 100349. <https://doi.org/10.1016/j.caeai.2024.100349>
- Liu, X., Fang, Y., & Lan, X. (2025). Regulations, technology policies and universities' attitudes to artificial intelligence in China. *Higher Education Quarterly*, 79(4), Article e70055. <https://doi.org/10.1111/hequ.70055>
- Meyer, J., Jansen, T., Schiller, R., Liebenow, L., Steinbach, M., Horbach, A., & Fleckenstein, J. (2024). Using LLMs to bring evidence-based feedback into the classroom: AI-generated feedback increases secondary students' text revision, motivation, and positive emotions. *Computers and Education: Artificial Intelligence*, 6, Article 100199. <https://doi.org/10.1016/j.caeai.2023.100199>
- Miao, F., & Holmes, W. (2023). *Guidance for generative AI in education and research*. UNESCO. <https://doi.org/10.54675/EWZM9535>
- Ngo, T. T. N., Chen, H. H. J., & Lai, K. K. W. (2024). The effectiveness of automated writing evaluation in EFL/ESL writing: A three-level meta-analysis. *Interactive Learning Environments*, 32(2), 727–744. <https://doi.org/10.1080/10494820.2022.2096642>
- Qian, L., Cao, W., & Chen, L. (2025). Influence of artificial intelligence on higher education reform and talent cultivation in the digital intelligence era. *Scientific Reports*, 15(1), Article 6047. <https://doi.org/10.1038/s41611-1618-81611-1618>
- Sawyer, R. K. (2017). Teaching creativity in art and design studio classes: A systematic literature review. *Educational Research Review*, 22, 99–113. <https://doi.org/10.1016/j.edurev.2017.07.002>
- Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology*, 60, Article 101832. <https://doi.org/10.1016/j.cedpsych.2019.101832>
- Tang, C., Mao, S., Naumann, S. E., & Xing, Z. (2022). Improving student creativity through digital technology products: A literature review. *Thinking Skills and Creativity*, 44, Article 101032. <https://doi.org/10.1016/j.tsc.2022.101032>
- Wang, W., Wang, Y., Chen, J., Wang, X., Zhang, H., Guo, C., & Peng, Y. (2026). The effectiveness of AI-supported personalized feedback on students' learning outcomes and motivation: A meta-analysis. *Journal of Educational Computing Research*, 64(3), 724–755. <https://doi.org/10.1177/07356331.251410020>

- Wang, X., Huang, R. T., Sommer, M., Pei, B., Shidfar, P., Rehman, M. S., Ritzhaupt, A. D., & Martin, F. (2024). The efficacy of artificial intelligence-enabled adaptive learning systems from 2010 to 2022 on learner outcomes: A meta-analysis. *Journal of Educational Computing Research*, 62(6), 1568–1603. <https://doi.org/10.1177/07356331241240459>
- Winstone, N., & Carless, D. (2020). *Designing effective feedback processes in higher education: A learning-focused approach*. Routledge. <https://doi.org/10.4324/9781351115940>
- Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), Article 39. <https://doi.org/10.1186/s 41239 -1611-1618-0>
- Zeng, Y., Md Noor, H., & Sabri, M. F. (2026). Artificial intelligence in fine arts education: A systematic literature review. *SAGE Open*, 16(2). <https://doi.org/10.1177/21582440261447959>

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Author Declaration

The authors declare that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere.

Kien Tsong Chau: Corresponding Author: kientsongchau@usm.my

Wan Ahmad Jaafar Wan Yahaya: wajwy@usm.my