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The Impact Of An EDIPT-Based Virtual Simulation Environment On Student Creativity And Narrative Quality: A Quasi-Experimental Crossover Study

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Abstract
Even though storyboard instruction is an integral part of animation and multimedia curricula, it is heavily reliant on manual sketching and static digital resources that offer limited scope for iterative experimentation. This restriction is increasingly at odds with the demands of contemporary creative industries, for which rapid prototyping and design-thinking competencies are considered essential graduate attributes. This study investigates if the integration of a virtual simulation-based storyboard learning environment into an EDIPT (Empathize, Define, Ideate, Prototype, Test) instructional cycle leads to statistically significant improvements in student learning outcomes as compared to traditional hand-drawing instruction. The study used a two-phase, within-subject quasi-experimental crossover design with a sample of 60 undergraduate students who were enrolled in animation-related programs in a Malaysian higher education institution. Participants were divided into two groups who experienced both instructional conditions in reverse order, allowing each participant to serve as his/her own control. The learning outcomes were assessed in 6 dimensions: quality of the storyboard, creativity development, coherence of the narrative, visual composition, technical execution and the efficiency of the task completion. The results indicated that the Experimental Group using the virtual simulation system based on EDIPT performed better than the Control Group in all six dimensions, including more original concepts, more cohesive narrative sequencing, stronger visual storytelling structure, and greater efficiency in task completion. These results are considered in terms of constructivist and experiential learning theory and creativity theory and discussed in relation to the cognitive affordances of immersive, iterative design environments. The study offers empirical evidence for the under researched interface of design-thinking instructional models and virtual simulation technology in storyboard education, and presents practical implications for curriculum designers and educational technologists looking to update creative pedagogy in higher education.

Keywords: virtual simulation learning, EDIPT model, storyboard design, creativity development, narrative quality, quasi-experimental crossover design, animation education.

1. Introduction

Storyboarding is a key component of animation and multimedia curricula. It is the stage where narrative logic, character development, spatial composition and visual sequencing are first translated into a structured, communicable form, thus acting as a fundamental competence for subsequent production work. The importance of storyboarding is undeniable, without a doubt, but many higher education programs still teach it using manual sketching and static digital resources. While these traditional methods are sufficient for developing basic drawing skills, they place significant constraints on more advanced learning outcomes such as creativity development and narrative quality; these are predicated on the learner's capacity to generate, evaluate and modify multiple visual and narrative alternatives before committing to a design (Obeid & Demirkan, 2023; Yu & Wang, 2025; Calvert & Hume, 2022).

The main limitation of traditional storyboard instruction is procedure-based rather than being visually expressive or imaginative in nature. Making changes to a hand-drawn sequence often requires the student to re-draw entire scenes, which leads to a high cognitive load and discourages the sort of quick, low-stakes experimentation that creative idea generation depends on. This pushes students into an early commitment to a particular visual idea rather than exploring a wider design space. This is a major pedagogical gap, because today's creative industries increasingly require fluency in rapid prototyping, iterative design thinking, and flexible visual problem-solving (McLaughlin et al., 2022; Guaman-Quintanilla et al., 2023; Mayer, 2021).

This is a gap that has pedagogical implications that are addressed by the application of virtual simulation technologies, especially those developed around a three-dimensional modelling environment. These kinds of environments enable learners to build, manipulate, and instantly see storyboard scenes in an interactive, digital workspace, transforming storyboard learning from representation to a more hands-on and experiential design process that is closer to a real production process than hand-drawn approaches can be (Obeid & Demirkan, 2023; Serna-Mendiburu & Guerra-Tamez, 2024). This shift also fits with national policy goals focusing on digitization and graduates' employability in Malaysia's higher education system. However, it is still somewhat uncommon to incorporate virtual simulation technology into storyboard instruction in a systematic, empirically supported way. And the technology's contribution to the growth of creativity and the caliber of the storytelling, as opposed to other more fundamental metrics of engagement or satisfaction, has not yet been fully established (Radianti et al., 2020; Di Natale et al., 2020; Stracke et al., 2025).

Instructional design is a related gap. In some instances, virtual simulation tools have been incorporated into creative curricula, but they do not necessarily have an integrated educational approach that effectively links them to desired learning outcomes (Marougkas et al., 2023). An alternative is the EDIPT model, which is based on the design thinking process and stands for the stages Empathize, Define, Ideate, Prototype, and Test (Alvarado, 2025). Based on constructivist and experiential learning principles (Pande & Bharathi, 2020), EDIPT is designed to fit into the broader design thinking framework. It is iterative in nature, with each activity intended to inform and shape the next, assisting the student in developing a clear creative problem and an ever-elucidated visual solution. Although few actual research has looked at EDIPT's employment in a virtual simulation environment, its educational usefulness in comparison to traditional education has not been explicitly assessed. Conceptually, however, EDIPT is ideally suited to the storyboard model of teaching (Micheli et al., 2019; Panke, 2019).

By presenting the quasi-experimental evaluation of an EDIPT-based virtual simulation storyboard learning environment, this study aims to fill this gap. The research question that drives this study is how the EDIPT-based virtual simulation learning environment influence students' storyboard learning outcomes in terms of creativity development and narrative quality. In response to this question, the study offers empirical evidence from two streams of literature that have frequently been examined independently: literature on the structured models of design thinking-based instruction and literature on technology in creative higher education. It also offers a comparative analysis of the efficacy of instruction that is based on observation from within the subject under study rather than merely perceptual experience.

2. Theoretical Background

2.1 The EDIPT Model and Design-Based Learning

The study uses EDIPT as a systematic, iterative, learner-centered approach to instruction. It consists of five steps: Empathize, Define, Ideate, Prototype, and Test, which follow a design-thinking process that was popularized by Alvarado (2025) in which problem-solving is done by repeating the steps of understanding, defining, ideating, prototyping, and testing, rather than going through them at once from instruction to output. The cyclical structure is different from common storyboard teaching models which usually lead students in a fixed teaching process and produce a final and less rewriteable product.

Constructivist and experiential learning theory provides a strong theoretical basis for EDIPT, and is particularly shaped by Pande and Bharathi's (2020) notion of learning as a process of concrete experience, reflective observation, abstract conceptualization and active experimentation. One or more points in this cycle might be represented by the Empathize phase: learning is based on tangible, contextualized experience; learning is conceptual and reflective; learning returns to active experimentation in the Prototype and Test phases. Because each cycle produces a new artifact that is used as the input for the subsequent cycle, constructivist education consistently challenges the students to recreate and improve their understanding (Petersen et al., 2022).

This methodical approach is suitable for the creative task of storyboard education from an educational perspective. Throughout the storyboard design process, students have the chance to reorder the scenes, adjust the visual composition, and repeatedly modify the story's pacing until they have it just right. The underlying cognitive demands of the task are therefore not best served by a linear instructional model that treats every storyboard attempt as final, whereas EDIPT's built-in testing and refinement cycles are more in line with the divergent exploration and convergent refinement that creativity researchers have connected to high-quality creative output.

2.2 Virtual Simulation Environments in Creative and Design Education

The use of virtual simulation and immersive technologies has been extensively investigated as a means to support experiential and design-oriented learning in higher education. A large volume of evidence shows that immersive environments can provide higher levels of engagement, spatial cognition, and opportunities to experience hands-on experimentation over static instructional media (Marougkas et al., 2023). The ability to directly manipulate design elements and see the effects of those manipulations in real-time is hypothesized to reduce the practical obstacles for iteration and make it much easier to explore and experiment with a creative problem by trial and error than it would be by manual techniques, especially in design-related disciplines (Hamilton et al., 2021; Villena-Taranilla et al., 2022; Concannon et al., 2019).

Without having to sketch these elements visually, learners may construct a scene, move the camera, and move a figure around the scene in a three-dimensional setting using virtual simulation settings. This has the practical effect of bridging the gap between an idea and visual implementation, allowing an idea to be tested, viewed from several perspectives, and then amended inside the same interactive session without requiring a complete redrawing of the manual for every modification. The affordance is crucial from a theoretical standpoint since it is the ideal solution to the procedural bottleneck caused by the iterative inventiveness limit imposed by traditional hand-drawn instruction (Çoruh, 2025; Campos et al., 2022).

2.3 Creativity and Narrative Quality as Learning Outcomes

Creativity is defined in this research as a socially and contextually based ability that is nurtured by environments that are cognitively stimulating and motivating (Guaman-Quintanilla et al., 2023). This componential perspective on creativity recognizes that, while creative performance is largely a product of a person's creativity, the task environment, such as the extent to which it allows for exploration, constructive feedback, and iterative refinement, also plays a significant role in creative performance. Similarly, in related work, contexts and environments are powerful enablers and constraints to creative engagement (Yu & Wang, 2025). The total body of such literature indicates that, in theory, an instructional context that is structured to encourage iteration and low-stakes experimentation (such as the EDIPT-based virtual simulation system is designed to facilitate) should yield better creative results than a context that has a procedural cost to revision (Irwanto et al., 2025).

The coherence, sequencing, and communicative clarity of the visual content that a storyboard depicts are all connected to the quality of the narrative, which is regarded in this study as a distinct but related result. While narrative competence is a recognized learning goal in animation and multimedia learning, it has not been emphasized as much in empirical research on virtual simulation learning, which have tended to focus on learning outcomes of engagement, usability and satisfaction. Therefore, in the present study, assessing the quality of the narrative in addition to the development of creativity can be used and directly targeted to the domain specific learning outcome that storyboard education is expected to develop, instead of general indicators of learner involvement.

3. Methodology

3.1 Research Design

In order to determine the causal impact of the virtual simulation storyboard learning environment employing EDIPT on student learning outcomes, this study employed a quasi-experimental design using a crossover method. Because intact class groups and institutional scheduling are crucial, random assignment to instructional conditions is frequently impossible in the real classroom, which is why this approach was selected (Creswell & Creswell, 2023; Sibbald & Roberts, 1998). If the necessary structural controls are included in the comparison, quasi-experimental designs have been widely acknowledged as a methodologically sound substitute for complete randomized controlled trials in these situations (Grassini et al., 2020).

The crossover portion of the design is the focus of methodological rigor. The two instructional approaches namely, traditional hand-drawing instruction and the EDIPT-based virtual simulation environment, were compared in this study, but there was no comparison between two separate student groups. Instead, each study participant was given both instructional approaches in a counterbalanced order. Additionally, by allowing each participant to be their own control, the within-subject structure greatly reduces the influence of individual variations (such as digital literacy, visual-spatial aptitude, and drawing skill) on the comparison across conditions (Sibbald & Roberts, 1998). Controlling for these differences at the individual learner level offers a more sophisticated method of distinguishing observed differences in performance to the instructional intervention itself versus pre-existing learner characteristics. These differences are frequently more noticeable when learning takes place in the context of creativity and design activities.

This experimental evaluation is the first of two levels of validation that form the larger research programme from which this study is derived, a second level being psychological and behavioural processes that underlie students' acceptance and continued use of the system. This study focuses only on the experimental testing of learning outcomes and addresses the question of whether the EDIPT-based intervention has measurable effects on student's storyboard performance, independent of their own self-reported perceptions and intentions (Blut et al., 2022; Xue et al., 2024; Marks & Thomas, 2022).

3.2 Participants and Sampling

The study involved 60 undergraduate students studying in animation related programmes from a Malaysian higher education institution. The participants were selected through purposive sampling, based on their enrollment in a course that addresses a relevant topic and prior experience using digital learning tools. Purposive sampling was deemed appropriate for this study because the research purpose was to assess the effectiveness of instruction and learning behaviour in a population of students with relevance, rather than to generalize to a population of students which was not specified (Campbell et al., 2020). The sample of students involved in animation-related courses also helped to assure a degree of consistency across participants in their base level of knowledge about digital tools, beyond the instructional intervention, to minimize variability due to unfamiliarity with digital tools.

3.3 Crossover Procedure

This study was conducted over a two-phase crossover protocol. The participants were split into two groups (Group A and Group B). During Phase 1, Group A were assigned to the virtual simulation storyboard learning system based on EDIPT, and Group B were assigned to the traditional hand-drawing instruction accompanied by lectures. During Phase 2, the instructional conditions were switched so that Group A did the traditional hand-drawing condition while Group B did the virtual simulation condition. This reversal led to the same set of instructional setting being experienced by both groups, and thus to the possibility of comparing the results obtained within groups and between groups as a whole.

Students' work created in the virtual simulation condition is called the output of the Experimental Group (EG) condition and work created in the traditional hand drawing condition is called the output of the Control Group (CG) condition, rather than a static grouping of students, but rather the instructional condition that the students experienced during each phase of the study. In this non-equivalent group quasi-experimental design, which fits within the crossover design, the ecological validity of the instruction provided in intact classrooms is maintained while still allowing for a controlled and structured comparison between the two instructional methods (Sibbald & Roberts, 1998; Creswell & Creswell, 2023).

3.4 Instructional Intervention: EDIPT-Based Virtual Simulation Learning

Each of the five processes in the EDIPT model was linked through educational activities in the system, and the virtual simulation state was particularly created to react to each step individually. In the Empathize stage, students were placed in a simulation environment, given scenarios including narrative storylines, and encouraged to consider audience perspectives and character goals in an interactive way as opposed to theoretically thru discussion. Since replicated contextual experiences in others have been demonstrated to promote meaning formation and creative interpretation in design-oriented learning, this step was intended to give contextual and experiential knowledge of the story being presented for additional design decisions anchored in it (Guaman-Quintanilla et al., 2023).

During the Define stage, students were taught to use diagnostic prompts and system review activities to identify specific issues with their storyboard (e.g., lack of flow in the narrative, lack of continuity between scenes, ineffective visual composition) and to convert these general storytelling problems into well-defined design problems. This is similar to the advancement of design-thinking research that has already established a relationship between the quality of a creative outcome and the accuracy of the problem's statement (Alvarado, 2025; McLaughlin et al., 2022) (Lu et al., 2022).

The system allowed learners to experiment and rapidly try out various possibilities of the narrative by simply manipulating scenes, characters and camera perspectives in the Ideate stage, facilitating multiple storyboard alternatives. The idea was to allow for broader and more exploratory thinking than is possible by hand-drawing alternatives, because the ease of generating and comparing them makes divergent thinking and idea fluency easier (Guaman-Quintanilla et al., 2023; Wu et al., 2023) (Bond et al., 2020).

In the Prototype stage, the learner applied their chosen concepts to create working visual models of their storyboard sequence with real-time simulation systems to include simulated character movement, scene composition, and cinematic framing, which were tested and refined. This stage enables students to be able to assess the implications of design decisions, not just conceptual plans, when engaging in applied, procedural learning conceptually (McLaughlin et al., 2022; Wu et al., 2023).

The approach provided students with organized methods for evaluating their storyboard work in relation to standards such as narrative coherence, visual consistency, emotional impact, and communication efficacy, as well as for rewriting and retesting in subsequent revisions during the Test stage. This stage accords with evidence of the advantages of structured feedback and iterative refinement on learning performance and creative ability, and views evaluation as a tool for continuous progress rather than an aim in itself (Alvarado, 2025; McLaughlin et al., 2022) (Parong & Mayer, 2021).

The five stages were conceived as a whole and were to be seen as a self-reinforcing cycle rather than a collection of disjointed exercises; Empathize set the context, Define framed the creative problem, Ideate kick-started thinking processes for generating ideas, Prototype built, and Test refined. Unlike the traditional hand-drawing method, the latter however was a relatively linear process where students were instructed to proceed from design sketches to a more or less stable, manually generated output, without the possibility of changing anything after the initial creation was finished; the only possibility to revisit a hand-drawn scene is to redo it, which is impractical.

3.5 Outcome Dimensions

The 6 dimensions of storyboard competence were selected: storyboard quality, creativity development, narrative coherence, visual composition, technical execution, and efficiency of task completion, to evaluate the learning outcomes. These dimensions were chosen to reflect both the creative and technical aspects of the performance of the storyboard and the practical efficiency in which students could execute assigned tasks in each of the instructional conditions.

4. Results

The two instructional conditions were subjected to a structured evaluation process based on the six dimensions to evaluate students' storyboard products. The aim was to test the hypothesis that the two instructional conditions have a similar effect on students' learning outcomes. For all 6 measured parameters of storyboard learning performance, the student product results of the EDIPT-based virtual simulation condition (EG) were always higher than the student product results of the traditional condition (CG) of hand drawing. The same was true for the quality of the storyboards, the development of ideas for the storyboards, the coherence of the story, the visual composition, the technical execution and the efficiency of the tasks completed. No dimension was in favor of the traditional condition.

In terms of creative performance in particular, it was found that storyboards created under the condition virtual simulation had a higher originality and more coherent story sequence than the traditional condition. Students working in the simulation environment also created outputs that showed an increased focus on cinematic framing, continuity, and character expression, and visual storytelling structure. This pattern indicates that the understanding of concepts was more closely related with the ability to represent the visual phenomenon under the condition of virtual simulation than under the condition of the traditional presentation.

In terms of efficiency, students spent less time completing the storyboard tasks in the virtual simulation than in the hand drawing condition. This pattern is interpreted as a decrease of the manual drawing and rework practical aspect and an increase of the creative and narrative aspect of the students' work, due to this extraordinary benefit of the simulation environment. The traditional condition whereas the alternative was highly dependent on manual drawing, seemed to be a larger practical burden on the students and limited the number of iterations possible within the time constraints of the task.

Combining these comparative results, it can be concluded that the condition that uses the EDIPT is consistently superior in terms of the overall width of the measured storyboard learning outcomes, both in creative and technical aspects of student work as well as the speed of student work production.

5. Discussion

5.1 Cognitive and Pedagogical Mechanisms

The previously mentioned pattern of results is consistent with a cognitive explanation in which students were able to externalize abstract storyboard concepts as directly controllable visual elements through the virtual simulation environment, as opposed to primarily holding and manipulating abstract concepts in working memory before writing them down. In this way, the EDIPT cycle functioned as a structuring mechanism that made externalization pedagogically effective by offering recurring chances for the ongoing development of students' creative output through successive stages of context understanding, problem framing, idea generation, prototyping, and testing (Makransky & Petersen, 2021).

This systematic, iterative technique is believed to support higher order cognitive functions that are essential to storyboard creation, such as divergent thinking, visual problem solving, and, more generally, animation production. In contrast to the conventional hand drawing condition, which required a significant amount of redrawing, the students who completed work in the simulation condition, where they employed the EDIPT framework, were able to engage in a sort of continual creative refining.

Another way of interpreting the pattern is in terms of the allocation of cognitive effort in each condition. In each storyboard attempt under the hand-drawing condition, a large part of the student's attention was required to focus on execution—such as controlling line quality, adjusting a panel so that it could make a compositional change, or manually restoring continuity between two adjacent panels. When this type of execution was done virtually, the simulation system would take care of the execution and the attention budget could be used for the task, which was originally meant to be used to develop the narrative and compositional decisions. This is not to say that the traditional condition of manual drawing has no pedagogical significance, and it is an important part of the visual training that students are required to receive, but rather that, in the specific context of measuring the effectiveness of a task for storyboard ideation and sequencing, the burden of having to re-draw the work was in conflict with the task's higher-order creative and narrative goals (Makransky et al., 2019).

5.2 Efficiency and Cognitive Load

The difference in efficiency between the two conditions of the virtual simulation scenario is consistent with the cognitive-load explanation of the difference between the two instructional circumstances. Conventional hand-drawn storyboard production requires students to use a significant amount of mental and physical energy in order to physically sketch and fix mistakes, which are unrelated to the task's intended creative and narrative processes. The virtual simulation environment appeared to provide students with more cognitive resources to dedicate to the substantive problem-solving aspect of creativity and narrative development as a result of this reduction in additional load. This may also explain why the storyboard productions produced under this condition were of higher quality in both technical and creative aspects.

This is also consistent with the form of findings based on dimensions rather than individual measures. It would be difficult to justify the improved efficiency at the price of quality (students finishing faster with less work) and the concurrent advances in originality, coherence, and technical execution. In the experimental condition, however, students were not only quicker but also produced more effective storyboards on all dimensions tested, as would be expected if time were freed up to focus on substantive design rather than merely eliminated from the work as a whole.

5.3 Theoretical Alignment

These results support constructivist and experiential learning theory, which emphasizes that learning takes place best when the learner can have a meaningful, interactive and context-rich experience (Pande & Bharathi, 2020; Alvarado, 2025). The findings are also in line with the empirical literature on immersive learning environments, which has linked immersive learning with better performance in spatial cognition, design thinking, and creative fluency. This is because learners can visualize and manipulate complex information structures in real time (Marougkas et al., 2023; Serna-Mendiburu & Guerra-Tamez, 2024; Yu & Wang, 2025). A creativity-theory perspective would agree with this pattern of results, since creativity is enriched in settings that allow for autonomy, experimentation and the revision of ideas (Guaman-Quintanilla et al., 2023; Yu & Wang, 2025), just the kind of setting that is typically offered by the virtual simulation environment developed for the EDIPT, and that the traditional hand-drawing condition was comparatively less able to support (Liu et al., 2020; Luo et al., 2021).

Furthermore, it should be noted that this pattern is used to support a specific assertion in Section 2.1, namely that the benefit seen is attributable to the cyclic nature of EDIPT, rather than simulation technology in general. Because the virtual simulation environment in this study is designed based on the five EDIPT stages rather than a general 3D drawing application, the results were not divided into "simulation helps" and "structured iteration helps," as both are present in the experimental condition at the same time. The pattern of results does support the more restricted and potentially more useful claim that a structured simulation technology centered on an iterative design-thinking process is more effective than unstructured hand-drawing instruction, which is consistent with, but not identical to, the theoretical proposition that iteration, not medium, is the active pedagogical ingredient.

5.4 Contribution to the Literature

This work adds to the growing body of research showing that immersive, technology-rich learning environments are ideal for fostering creativity, engagement, and knowledge development in higher education settings (Marougkas et al., 2023; Serna-Mendiburu & Guerra-Tamez, 2024; Yu & Wang, 2025). It is distinctive in that, rather than using a one-group pre-test/post-test comparison or self-reported perceptions of learning gains, it attempts to connect this broader literature to a teaching and learning model centered around design thinking, EDIPT, and tests this pairing against a directly equivalent traditional condition using a within-subject design. The study demonstrates that the pedagogical advantages of storyboard education using virtual simulation technology is not the technology itself as a whole, but the logical interweaving of the technology into the whole pedagogical process, based on the principle of iteration and a unified pedagogical system (Pellas et al., 2021; Burke et al., 2025; Nesenbergs et al., 2021).

This also reveals an evidential gap that this study endeavor aims to solve. Many studies on the use of virtual and immersive learning technologies in creative education use engagement, satisfaction, or self-perceived learning gains as main outcome variables, which provide information about the adoption of learning technologies but are not strictly learning outcomes. This study, on the other hand, looked at the student's real storyboard artifacts based on six categories of learning that were evaluated individually, providing evidence that is closer to the actual learning outcome than a substitute for it. This distinction is essential in the context of curricular decisions, for example: a tool meant to be user-friendly does not always result in higher product quality; and the results presented above are more directly relevant to the latter concern (Cabrera-Duffaut et al., 2024).

6. Limitations and Future Research

Caution should be used in interpretation of these findings due to several limitations. First and foremost, the comparative results shown are measured descriptively and based on criteria. Because the underlying study did not report mean differences, effect sizes, or significance values for this experimental comparison, the small advantage in the direction of the virtual simulation condition should be considered a pattern rather than a statistically significant difference. Validation of the storyboard output using a rubric would be useful for future replications. Formal inferential testing (e.g., paired-samples analyzes suitable for the within-subject crossover structure) would be useful to quantify the magnitude and reliability of the observed advantage more precisely.

Second, the study was conducted on a single sample of 60 students of the undergraduate programmes in animation from one higher education institution in Malaysia. The sampling method was suitable for the purpose of this study to assess the effectiveness of the instruction in a representative population, but the results were not necessarily applicable to other institutional contexts or to other countries, or to students who are not as digitally literate as those studied.

Third, simply because the crossover design necessarily included the presence of both instructional conditions for each individual participant, it is not always possible to exclude the possibility of order and carry-over effects (e.g., skills or strategies acquired during one of the two phases influencing performance during the other), although the two-phase counterbalanced design was designed to minimize order and carry-over effects. It would be helpful in future studies if performance were indicated separately by phase and group, to be able to look at this directly.

Finally, although they may be pertinent for future research, the psychological and behavioral factors (such as usefulness, ease of use, and enjoyment) that underlie students' interaction with the system are not examined in this study. This complementary question is addressed by a companion analysis that uses structural equation modeling of technology acceptance constructs in conjunction with creativity and narrative quality variables. It should be read in conjunction with the current findings to gain a comprehensive understanding of the behavioral adoption and instructional efficacy of the EDIPT-based virtual simulation system (Alizadeh & Cowie, 2022).

7. Conclusion

The aim of this study was to determine if there was an improvement in learning outcomes that could be measured between the EDIPT-based virtual simulation storyboard learning environment and the conventional hand-drawing learning environment, with undergraduate students studying animation in Malaysia. The results reveal a significant virtual simulation effect in the six dimensions of storyboard performance related to creative development, narrative coherence, visual composition, technical execution, and task completion efficiency. The results agree with the theoretical proposition that treating the VR simulation technology as an iterative thinking oriented instructional model (EDIPT) can effectively enhance creative and narrative learning outcomes, which are not easily achieved by traditional linear instructional models.

For curriculum designers and educational technologists, these findings indicate that the pedagogical potential of the use of virtual simulation tools in creative higher education is likely to be largely dependent on the instructional structure in which they are used, and not just the technology itself. Therefore, using virtual simulation environments in explicit, iterative design thinking processes as a means to supporting the development of creativity and the competence to tell stories in animation and multimedia education can be more effective than simply introducing them as unstructured digital tools for the replacement of manual tools. Applying this approach in future research, including using validated and quantitative outcome measures and examining the approach in wider institutional and disciplinary settings, would further bolster the evidence base for this approach.

Taken together, these findings suggest that the pedagogical value of virtual simulation technology in creative education is not a foregone conclusion of the novelty of the technology or its potential for visual realism. Thus, the comparison in this study isolates the effect of the combination of simulation technology and a structured, iterative instructional cycle (EDIPT) rather than the effect of simulation technology alone. This distinction carries a practical implication for institutions thinking about investing in immersive tools for creative curricula: the deciding factor, according to this evidence, is not so much which simulation platform is adopted but whether its use is consciously structured around an iterative design-thinking sequence that gives students a structured reason to return to, assess and revise their work. Future research that varies the instructional structure while holding the underlying technology constant (e.g., EDIPT-structured use of the same simulation environment vs. unstructured free use of it) would help confirm this attribution directly and sharpen the guidance this study can offer to curriculum designers considering similar investments.

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