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Research Article

A Quasiexperimental Study on Process Verification of the Animation Teaching System under the Background of Animation-Related Majors

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This article reports the results of an experimental study during the participation in the animation teaching system (ATS) by students of Digital Media Art at Kunming University (KU) and by students of digital media technology at Hunan University of Science and Engineering (HUSE), respectively. The experimental results are used to observe whether the students' scores on their work differed after using the ATS in different program contexts. The type of experiment in this study was quasiexperiment, with one experimental group and one control group at each university. Students from both universities participated in a pretest and a posttest. In accordance with the purpose of the study, we focused data analysis on the same group of posttest scores at both universities for analysis, i.e., two experimental groups for between-group comparisons and two control groups for between-group comparisons. The Mann–Whitney *U* test was used for comparative and quantitative analysis. The study examined that the experiment's digital media art students outperformed the digital media technology students. The article concludes with a discussion of how the ATS should be improved and enhanced for application in different animation-related majors.

1. Introduction

Chinese animation industry experienced a highlight moment in the last century and then went through a long period of silence. After entering the 21st century, the influx of foreign animation works gradually activated the development of the Chinese animation industry. The development of the animation industry accompanies the reform of animation education. Professional talent training in Chinese universities depends on the respective schools' situation [1–3]. From the perspective of the characteristics of the animation major itself. The positioning of the training of talents will be influenced by professional aspects [4], such as academic-oriented talent cultivation and professional skill-oriented talent cultivation. In fact, after graduation, most animation talents work in the industry's professional companies [5], rather than a large number doing academic research. Moreover, talent cultivation is also influenced by other factors, such as faculty strength and the dissemination and preservation of the region's culture. Ma [6] explained the opinion that universities have a sense of responsibility in the inheritance of intangible cultural heritage.

1.1. Chinese Animation Education. The conflict, which exists between talent cultivation in animation education and market needs, is an unavoidable problem. Haibin [7] mentioned that the most critical issue for Chinese animation

education is cultivating talent for the industry. The market's expectation for talent is no longer a single demand in China. The era when animators could do animation work by mastering software operation skills has quietly left. Employers hope there will be more intelligent, thoughtful, creative, and problem-solving interdisciplinary talents for the industry. Zhang and Meng [8] put forward the classification training of students and the establishment of the "7-2-1" training mode, which trains 70% of students into application-oriented talents, 20% into interdisciplinary talents, and 10% into top research talents. According to Zhang and Meng's research, the training of animation students in colleges and universities should be geared toward the direction of application-oriented talents, with academic talents accounting for only a tiny portion. Based on the author's previous research of the current station of Chinese animation majors in universities. The number of animation undergraduate majors in China tends to be stable without a significant increase, only a slight degree of elimination and change. In other words, most of the animation programs in these universities have survived the tests and requirements of the industry.

Currently, in Chinese animation education, University-Enterprise Cooperation is regarded as a new professional reform idea to reform animation specialty. The corresponding subject and teaching system should also be updated and studied in this context. For instance, Haibin [7] reported a study about an interdisciplinary type of talent cultivation mode in animation education in the School of Art and Design of Xi'an University of Technology. Zhang [9] studied Chinese animation higher education from four aspects: the curriculum design, the reconstruction of teacher construction, the implementation of practice links, and the launch of the international forums, respectively. Then posed the cultivation of "vision & insight" in animation education to explore a replacement scale for a more well-rounded education, then widely explore how to succeed. Many of the above factors directly determine that further study tends to be applied research. Dong and Zhang's research premise is that students already have the corresponding knowledge of animation and have a definite understanding and mastery of the creation basis of animation and the source of creativity. However, these patterns may be helpful in the higher grade. In the lower grades of beginners, we still need to focus on animation creation fundamental research to meet the novices in the learning needs.

The animation industry belongs to the category of the cultural and creative industry. One of the critical stages in animation creation that determines the quality of the work is the pre-production stage [10]. In 2010, Xing Chen, Jiang Wei, and Xue Huang surveyed 20 animation companies in Hangzhou, China. During their interview, the lack of creative talents is the critical reason for most Chinese animations' failure [11]. When beginners start to create animation, the main problem they face is the generation of ideas and the integrity of the storyline [12,13]. For example, as an animation story's core planner, the coordination and command ability thought the entire animation. In Chinese universities' animation design majors, there is often such a situation that there are many students with fine art skills and hand-painted ability, but their story composing ability is relatively low [14]. Thus, it is still a difficult task to balance both. Some previous researchers have considered solving this problem in the existing animation education research, which concerns applying design thinking to practical teaching and learning [15].

However, there is not just one design thinking model in the field of design thinking research, such as Stanford University's design thinking model [16] and the Double Diamond Theory [17] proposed by the Design Council [18] in the UK. The purpose of Chou is to introduce the design thinking method and apply it to social entrepreneurship projects [19]. In a study, Zhao Tianjiao, Sun Han, and Li Xiang apply Stanford's design thinking model to animation design to obtain a helpful method to get more creative ideas for animation production [20]. Diamond Theory is also a basic analytical framework for analyzing the opportunities and challenges that the Chinese animation industry faces. Based on this, it puts forward the Chinese animation industry's competitive advantages, hoping it will offer a reference for improving its international market competitiveness [21]. These well-established and long-established design models certainly have excellent merits and also be applied in varied fields, but their relevance in animation creation is still lacking. In this study, we also apply design thinking to teaching animation. However, compared to previous studies, the innovation in this study is to develop different design thinking formulas based on the structure of stories in animation creation. And the creative approaches are integrated into the creative process.

In this study, another issue concern that we not only focus on animation majors but also include animation-related majors. The animation majors in Chinese universities are not only the 346 existing ones, a number that the authors counted in their 2020 study based on data published by the Chinese Ministry of Education. If animation-related majors were covered, this total could reach the 1230 university faculties [22] offering animation-related majors. The branches of animation-related majors vary from university to university, with some differences in the way students are trained and the direction they are shaped. Animation-related majors include film and television postproduction, comics, digital media art, and digital media technology [23]. Therefore, this study focuses on digital media art and digital media technology students. The students involved in the experiment differ in their thinking patterns and their drawing techniques. The students of Kunming University (KU) belong to digital media art. The students of this college are characterized by having taken the corresponding art skills training before entering the university. Their admission process is to take the related art general examination [24] before taking the Chinese college entrance examination [25]. In contrast, students from Hunan University of Science and Engineering (HUSE) did not take any art skills training before entering the university and directly took the Chinese college entrance exam. The different entrance methods also reflect the difference in the students of the professional

course at the two universities during their four years of college. The above issue is also a key reference that we will consider when choosing the experimental site.

1.2. The Animation Education System (ATS). The animation teaching system (ATS) is a teaching and learning process (see Figure 1) designed for beginners in animation, expecting to effectively solve the problems teachers and students encounter in the teaching and learning process. The ATS in the context of the educational environment in China: an adoption of a coherent ATS by integrating coordinated design thinking (DT) and creative methods (CM) approach into animation pedagogy (AP) can cultivate creative idea development and problem-solving skills among animation students. As a whole, it is to help students to get started with animation creation quickly.

CMs were selected based on the aspects involved in the precreation of animation. In this study, we selected a total of five creative methods. The projects in precreation, including story ideas, storyboard design, and art design, are fixed. Therefore, we recommend the creative methods that are suitable to be applied in each segment in ATS. Animation creation is teamwork, so brainstorming is applied during collective discussion within the group, and the operation follows the existing steps. The "5W1H" determines the story's time, place, characters, main events, and other information. Instead of using the original meaning, the method redefines each item in the context of animation creation. Causal Layered Analysis (CLA) is mainly used in plot analysis, primarily to analyze the storyline's cause-and-effect relationships and logical relationships. Mind mapping is used in conjunction with other methods, such as brainstorming and "5W1H." The purpose of Synectics is to reduce the difficulty of creation by converting unfamiliar information to familiar by analogy. There is no fixed order or combination of the above-mentioned creative methods in ATS, and they are all used flexibly according to the creator's needs.

Furthermore, to understand the main workflow of the preproduction, one of the main aspects is to address the students in creativity and storyline design. Hence, assessing students' creation results focused on storyboarding and creativity. The assessment technic we adopt is the Consensual Assessment Technique (CAT).

2. Methodology

The ATS in this study wanted to use design thinking at the beginning of the design as a strategy for students to effectively organize the whole precreation in various matters, listing the problems in concrete and detail. Then, in solving different problems, suitable creative methods are used as aids to solving each problem in a targeted manner. In the actual teaching process, the Socratic question-and-answer method [10] is used to help students find the problems that need to be solved. The coevaluation technique can be referred to in the final evaluation of the work to assess the results. The research question in this study was whether students' outcomes in the ATS experiment and normal teaching (NT) process would vary across professional backgrounds. So the choice of the experimental site should not be limited to animation majors in professional colleges and universities but should also include universities that provide animation-related majors. This decision is because students in related majors face more learning problems than in professional institutions. Therefore, the idea of this study is firstly to study the combination of animation education with design thinking and creative methods and, secondly, to choose two universities that offer animation-related majors as the experimental location to fulfill the ATS verification. The methodological part of the study contains three sections: experimental design, animation pedagogy module design including NT and ATS, hypothesis and subhypothetical questions, and data analysis.

2.1. Experiment Design. The process verification for ATS is that we need to be in an authentic teaching process. Therefore we choose the method suitable for this study according to the actual needs. A quasiexperiment is an experiment in which the researcher cannot choose subjects. The majority of experimental studies in pedagogy are quasiexperiments [26]. Quasiexperiments are most to be expected to be conducted in field settings where the arbitrary assignment is difficult or impossible. In this study, we chose two naturally occurring classes so that individuals were not randomly divided, and the experimental procedure was accurately described as a nonequivalent group design [27]. Such experiments are used to assess treatment effects, such as psychotherapy or educational interventions [28]. Therefore, we used quasiexperiments to achieve the study.

The operation of this experiment was completed in March and April of 2021 in Kunming and Yongzhou, respectively. The research site in this study is in universities and colleges in mainland China that offer animation programs. Therefore, the main consideration in the research process is the problems and the current situation in the region. Moreover, the teaching quasiexperimental activities conducted in two of these universities were selected. Two naturally occurring classes of this major in their respective schools were chosen for the study. A total of two majors from two universities were invited to participate in the experiment. Two natural classes of the same major in each university were randomly assigned as the experimental group (EG) and the control group (CG).

Kunming University (KU) is located in Kunming, Yunnan Province, China (shown in Figure 2 location 1), and the students of this university have a background in digital media art. The experimental group consisted of 27 students, and the control group consisted of 20 students. Confirmed by the school's teachers, the class was randomly assigned when recruiting students. However, in their sophomore year, some students choose to transfer to other majors or leave school, resulting in the unequal number of students in each group encountered in our current experiment. In addition, the university's two groups of students are directly enrolled in the university after taking the fine art examination and the college entrance examination.

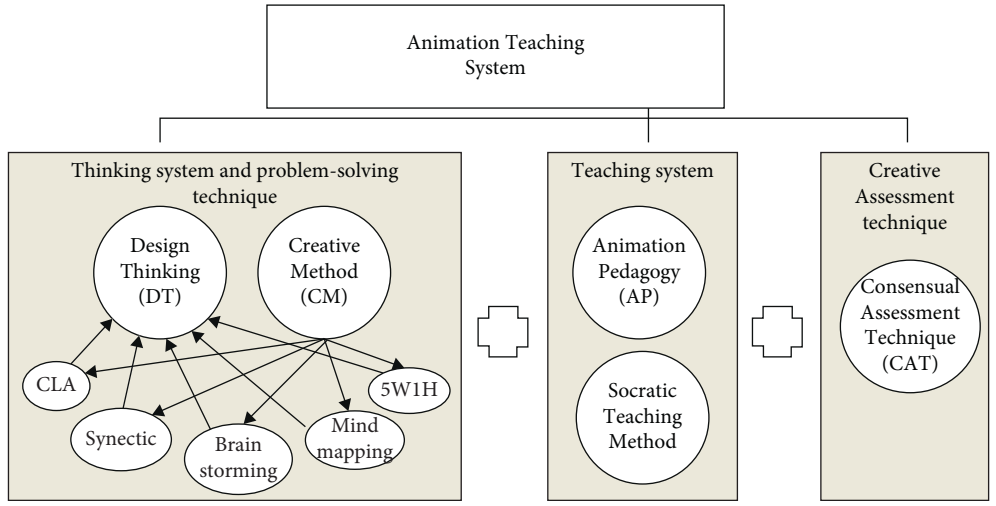


Figure 1: The animation teaching system (ATS) diagram (*Source*: author 2021).

Figure 2: The experiment locations in China (*Source.* author 2021).

Hunan University of Science and Engineering (HUSE) is located in Yongzhou, Hunan, China (shown in Figure 2 location 2), and the students' program background is digital media technology. The experimental group consisted of 35 students, and the control group consisted of 18 students. The two groups at HUSE were slightly more unusual than those at Kunming. The university's class size was set at 40 students per class, but the planned two and a half classes were reduced to one class due to a decrease in applicants that year. Therefore, we chose an alternative class for the control group in the experiment. The case of the substitute class is the same grade with the same major. The experimental group entered the university directly after taking the college entrance examination in this university. The students in the control group entered junior college after the college entrance examination and then reentered the university to improve their academic background. The objective presence factors are detailed in Table 1.

The students in control and experimental groups were taught the regular basic expertise to ensure that all

Table 1: Essential information and distinctions for participants.

	KU	HUSE
Major	Digital media art	Digital media technology
Differences in students' abilities	Students already have art skills before entering college	Students do not have art skills before entering college and will need to learn art skills when they enter their first year of college
Location	KU is located at the provincial level of the western part of China.	HUSE is located in a prefecture-level city in the central region of China
The difference in course length	Each class is 45 minutes long, with four consecutive classes per session.	Each class is 45 minutes long, with two consecutive classes per session

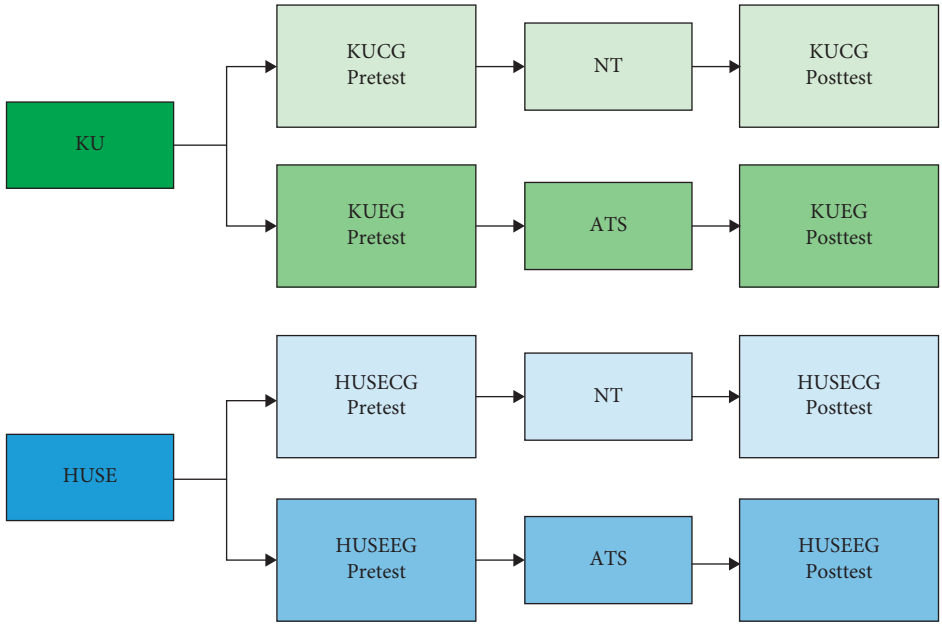


Figure 3: The experiment process (*Source*: author 2021).

participants had the same knowledge base. The students taking part in the experimental group were then taught the ATS to test the impact of ATS among students with different professional backgrounds. The quasiexperiment has two phases, the pretest before ATS and NT and a posttest after ATS and NT in two categories groups in each university. As shown in Figure 3, the experimental procedure introduces a graphic illustration of the experimental plan using a pretest and a posttest in the quasiexperiment process.

In the pretest and posttest, the researcher explains the topic and then assigns it to the participants. We will use the pretest topic as a teaching example for the students during the ATS presentation. We prepare two topics for the posttest, one main topic, and one alternative topic. The reason for alternative plan preparation is because if students in which university did not completely understand the experiment process led, the first topic to scrap. We have plan B to finish the experiment, as shown in Table 2.

Because the experiment needs to show some electronic data to students, we choose the classroom in the computer room for the experiment. The seating chart arrangement is shown in Figure 4. Due to the different seating layouts of classrooms in the two schools and the part of group discussion in ATS, it is necessary to display this chart for reference in subsequent research. The seating arrangement of HUSE is the regular class arrangement (see Figure 4(a)). Students are seated in rows, and teachers are seated in the front of the classroom. However, the seating arrangement of KU is arranged around the classroom, and the position of teachers is in the middle (see Figure 4(b)).

2.2. Animation Pedagogy Module Design. The animation pedagogy module is taught to students in the NT and ATS sections of the lab. The animation pedagogy module was standardized because we could not control the animation knowledge base of the students before the experiment. Therefore, uniform content needs to be prepared to ensure that participants have a uniform base of knowledge when participating in the experiment.

The section of NT is for both control groups and experimental groups students. The content contains the storyboard, incorporating design principles into storyboards, maintaining screen side, screen direction specifically on characters moving in and out of frame, motivating the camera: cuts. NT's lecture content is designed for the

Table 2: The topics for the pretest and posttest.

	Pretest	Posttest
DT formula	WHAT + ? = RESULT	WHAT + ? = ?
Topics	A donkey drowned in a teacup.	First topic: A night in the city, you ride a bike to go home on the way, suddenly you heard behind, someone called you: "stop!!." Who called you? What happened or will happen? The alternative topic: XX ancient tomb adventure. XX went exploring, entered the cave, and found an ancient tomb (covered with treasures and dead bones everywhere, gusts of gloomy wind came) suddenly . . .
Instruction	1. Based on the topic above, produce a storyboard. 2. For its roleplay, only one protagonist is allowed. It can be human, animal, etc. 3. There is no limitation on the story location or setting. 4. The frame for the storyboard should be limited between 10 and 15. 5. Once completed, please record spend time at the bottom right part of the storyboard.	1. Please continue to draw the story according to the plot provided earlier. 2. For its roleplay, only one protagonist (male or female) is allowed for both topics. Supporting characters for first topic: Ghost, dinosaur, and cat (optional, can draw all, can choose one of them). Supporting characters for alternative topic: ghost, snake, and cat (optional, can draw all, can choose one of them). 3. The location or background setting: first topic is in a busy city street; the alternative topic is in a forest. 4. 10–15 frames of the shooting scene, self-drafted title. 5. Once completed, please record spend time at the bottom right part of the storyboard.
Note	The topic assigned is based on an issue-based problem. The focus is more on "what" and "result" without specific attention on "how."	The topic assigned is based on a scenario-based problem. The focus is more on "what" without specific attention on "how" and result.

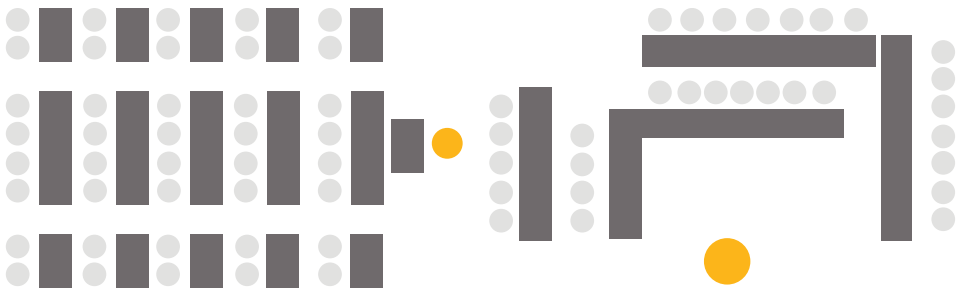


Figure 4: Plan of the experiment set in the computer room. (a) Plan of the experiment setting in the HUSE-computer room. (b) Plan of the experiment setting in the KU-computer room.

following reasons: first, the normal preanimation process is to generate a text script first, and then the subscreeners draw the subscenes based on the textual information. In our experiment, we will have students work in a storyboard format, combining script writing and split-screen script drawing. This decision was made because we wanted the students to quickly understand the various aspects of the animation process, such as script writing, scene design, character design, and split-screen scripting, in a relatively short period. And by starting directly with storyboard creation, they can synthesize these elements together. However, this would reverse the order of the regular process. However, Mou [29] has already done similar experiments in her research to complete script creation work in the form of storyboarding and got positive and positive results to confirm that this operation is feasible. Therefore, the first thing we introduced to the students in NT was about storyboarding. Second, design principles are incorporated into storyboarding. In the case of art colleges, design basics students are bound to have been exposed to in their elementary courses. However, it is not always well understood among non-art majors. Therefore, we included this part in NT and taught it as examples mainly by applying the design principles in storyboard creation. This ensured that the students had the same foundation and also showed them the specific applications. This facilitates flexible application in

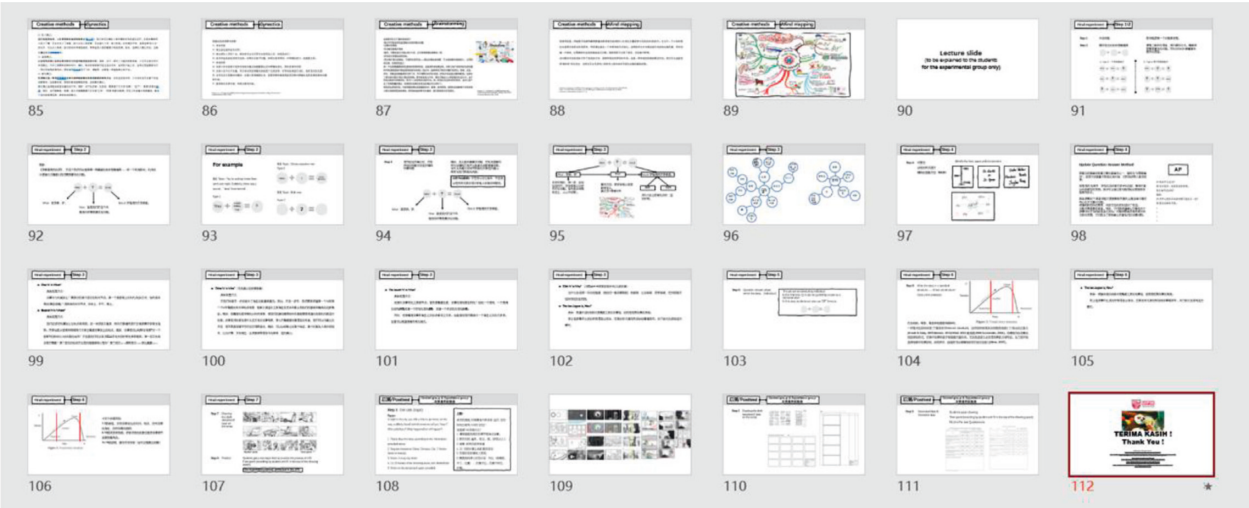


Figure 5: Part of ATS courseware.

subsequent experiments. The third part of the content is about the knowledge of film and television, including camera alignment, shooting angles, screen switching, and other content. These contents are also essential because the design of this shot in the early stage will affect the content of the work in the middle and later stages.

The section of ATS is only for experimental groups' students. The content contains design thinking, creative methods (5W1H, CLA, Synectics, Brainstorming, Mind mapping), and the application of the ATS. Parts slides of the ATS process as shown in Figure 5. The design thinking and creative methods are not used according to the original content and steps but are updated and adjusted according to the issues involved in creating the animation. For example, we adjusted the 5W1H method according to the actual needs of animation creation. The definition of "WHO" is changed to who the story's characters are. The new meaning of the "WHAT" is changed to what event or story happened. The "WHEN" was changed to when the story happened. Time should be specific to the chronological background and include the morning, noon, and evening. The reason is that detailed time information will affect animators to design the scenes and costumes. The ATS section has specific steps to use in addition to the basic introduction of the above content (see Figure 6). We have set up eight steps according to which the instructor will guide and teach the participants.

2.3. Hypothesis and Subhypothetical Questions. The goal of the quasiexperiment is to assess the effectiveness of ATS. We would like to find out if ATS advantages the realization of teaching practice and improves the animation storyboard creation of animation in solving storylines and creativity. We would also like to collect students' performance on the NT. Considering the set goal, we have chosen the hypotheses and subhypothetical questions:

Hypothesis: in terms of creativity and storyline ability, ATS can more easily influence the performance of students from different professional backgrounds in animation creation than the normal teaching process.

Subhypothetical questions (Sub-HQ) are as follows:

Sub-HQ 1. Is there any significant difference in the students' storyline scores between KUCG and HUSECG after the normal teaching process (at a .05 level of significance)?

Sub-HQ 2. Is there any significant difference in the students' creativity scores between KUCG and HUSECG after the normal teaching process (at a .05 level of significance)?

Sub-HQ 3. Is there any significant difference in the students' storyline scores between KUEG and HUSEEG after the ATS process (at a .05 level of significance)?

Sub-HQ 4. Is there any significant difference in the students' creativity scores between KUEG and HUSEEG after the ATS process (at a .05 level of significance)?

2.4. Data Analysis. The process and protocol (see Figure 7) for analyzing the experimental data were determined in accordance with the research objectives of this study. The process of analyzing the experimental data is shown in the figure, and a comparative analysis between the groups of the experimental group (KUCG vs. HUSECG) and the control group (KUEG vs. HUSEEG) of the two universities was conducted for the posttest. The analysis aimed to confirm whether there were gaps in students' performance from different professional backgrounds regarding creative and storyline processing abilities. The assessment follows the CAT and invites the teachers from each university to assess the creation. The quantitative instrument was in the form of a five-point Likert scale. The Kolmogorov–Smirnov test and the Shapiro–Wilk's W test were adapted to test the data's normal distribution. Then we adopted the Mann–Whitney U test to conduct the intergroup analysis.

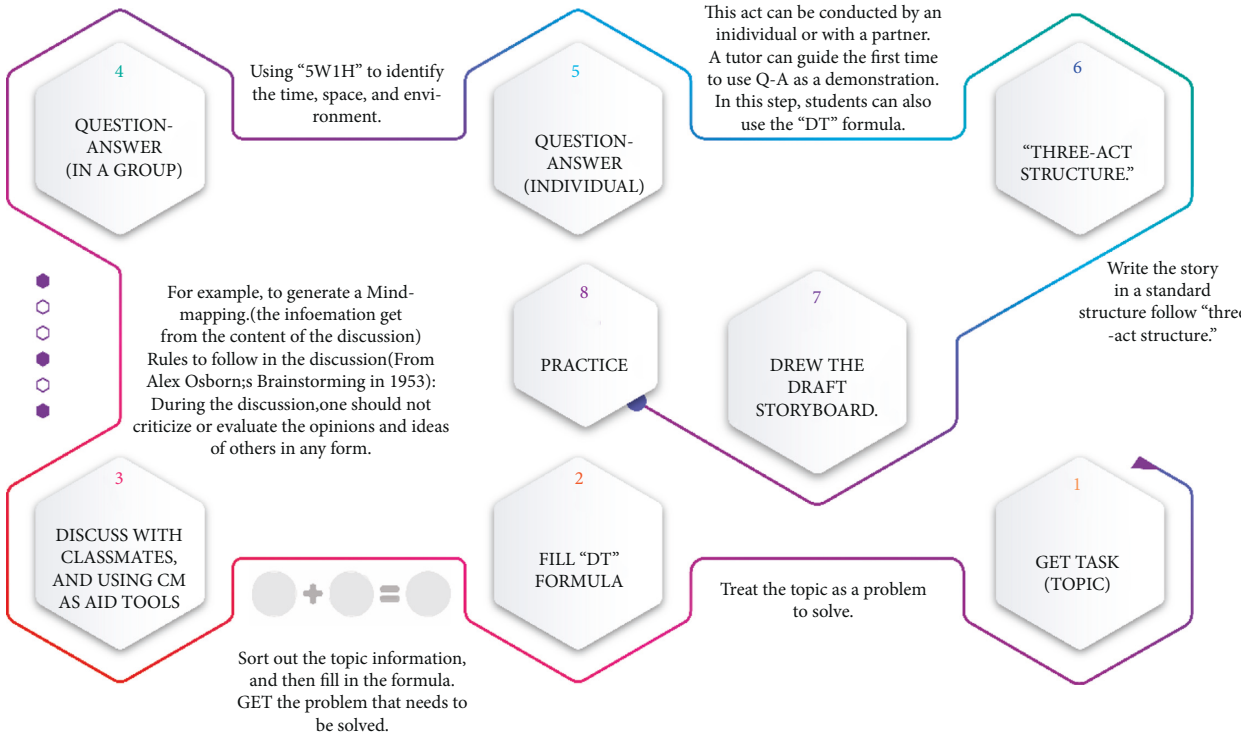


Figure 6: Eight steps in ATS.

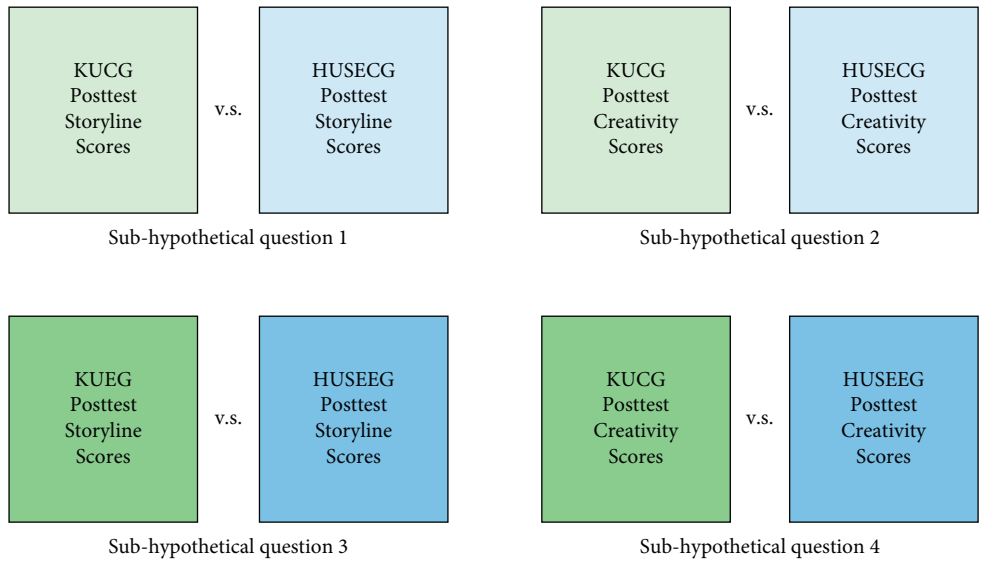


Figure 7: The diagram of the data analysis process (*Source.* author 2021).

3. Result

The results of the data analysis were analyzed in three steps for each subhypothetical question. First, the group was tested to determine whether the data conformed to a normal distribution and whether the data were of the parametric or nonparametric type to choose the following analysis method. Second, analyze the results of the posttest storyline with the appropriate analysis method. Third, the results of the creativity of the posttest are analyzed by the corresponding analysis method.

3.1. The Data Normality Test. Table 3 shows the Shapiro–Wilk's W test results of the data normality test. Since significant values were less than alpha, the null hypothesis can be rejected. We concluded that the data did not conform to the normally distributed. Therefore, we need to use the Mann–Whitney test when testing the difference for the four comparison items: the students' storyline scores between KUCG and HUSECG, the students' creativity scores between KUCG and HUSECG, the students' storyline scores between KUEG and HUSEEG, and the students' creativity scores between KUEG and HUSEEG.

Table 3: Data normality test result.

	Sig.
KUCG's posttest storyline scores	0.016
HUSECG's posttest storyline scores	0.001
KUCG's posttest creativity scores	0.001
HUSECG's posttest creativity scores	0.001
KUEG's posttest storyline scores	0.016
HUSEEG's posttest storyline scores	0.001
KUEG's posttest creativity scores	0.001
HUSEEG's posttest creativity scores	0.001

3.2. The Data Analysis Result for Answering Sub-HQ 1. The Mann–Whitney U test was conducted to determine whether there is a significant difference in the students' storyline scores between KUCG and HUSECG. The results indicate a significant difference between groups ($U = 84.00$, $p = 0.002$) (see Table 4). In conclusion, we can reject the null hypothesis and conclude that there is a significant difference in the students' storyline scores between KUCG and HUSECG after the normal teaching process.

Figure 8 displays the frequency of the storyline scores after NT in HUSECG and KUCG in the posttest. HUSECG ($N = 18$, Mean Rank = 14.17) shows in blue bars, and KUCG ($N = 20$, Mean Rank = 24.30) shows in green bars.

In terms of storyline, the HUSECG posttest results compared to the KUCG posttest results; the HUCG scores performed better than the HUSECG. Even after the teaching process of NT, students in the digital media art program performed better than digital media technology program students in terms of storyline.

3.3. The Data Analysis Result for Answering Sub-HQ 2. The Mann–Whitney U test was conducted to determine whether there is a significant difference in the students' creativity scores between KUCG and HUSECG. The results indicate a nonsignificant difference between groups ($U = 125.00$, $p = 0.061$) (see Table 4). In conclusion, we cannot reject the null hypothesis and conclude that there is no significant difference in the students' creativity scores between KUCG and HUSECG after the normal teaching process.

Figure 9 displays the frequency of the creativity scores after NT in HUSECG and KUCG in the posttest. HUSECG ($N = 18$, Mean Rank = 16.44) shows in blue bars, and KUCG ($N = 20$, Mean Rank = 22.25) shows in green bars.

In the evaluation of creative ability, HUCG scored better overall than HUSECG in the posttest results compared with KUCG. However, after the teaching process in NT, there was no significant impact on students' creative ability in the two universities, and no help was provided to students in their creation.

3.4. The Data Analysis Result for Answering Sub-HQ 3. The Mann–Whitney U test was conducted to determine whether there is a significant difference in the students' storyline scores between KUEG and HUSEEG. The results indicate a significant difference between groups ($U = 128.50$, $p = 0.001$) (see Table 4). In conclusion, we can reject the null hypothesis and conclude that there is a significant difference in the students' storyline scores between KUEG and HUSEEG after the ATS process.

Figure 10 displays the frequency of the storyline scores after ATS in HUSECG and KUCG in the posttest. HUSEEG ($N = 35$, Mean Rank = 21.67) shows in blue bars, and KUEG ($N = 27$, Mean Rank = 44.24) shows in green bars.

The results of the storylines in the two experimental groups showed that ATS impacted student performance at both universities and the frequency plots showed that KU students performed better than HUSE students overall.

3.5. The Data Analysis Result for Answering Sub-HQ 4. The Mann–Whitney U test was conducted to determine whether there is a significant difference in the students' creativity scores between KUEG and HUSEEG. The results indicate a significant difference between groups ($U = 143.50$, $p = 0.001$) (see Table 4). In conclusion, we can reject the null hypothesis and conclude that there is a significant difference in the students' creativity scores between KUEG and HUSEEG after the ATS process.

Figure 11 displays the frequency of the creativity scores after ATS in HUSECG and KUCG in the posttest. HUSEEG ($N = 35$, Mean Rank = 21.67) shows in blue bars, and KUEG ($N = 27$, Mean Rank = 44.24) shows in green bars.

From the evaluation results of creative ability in the two experimental groups, ATS impacts the scores of students in the two universities in this aspect, and it can be seen from the frequency chart that the overall performance of KU students is better than that of HUSE students.

4. Discussion

We first respond to the primary purpose of this study and hypothetical questions through the experimental results. The effects of ATS and NT on students during teaching and learning and the students' performance in using ATS in different professional contexts are described, respectively. Second, new issues identified during this experiment include the seating arrangement of students in computer classrooms and the impact of different university class schedules on students' learning are discussed.

4.1. ATS Positively Affected Students' Storyline Performance and Creative Ability. The Mann–Whitney U test analysis showed that the ATS positively affected storyline completion and creative ability for the experimental groups at both universities. This result is mainly consistent with the goals initially set by the ATS. Based on the NT, students were taught first to use design thinking to peel back the problem layer by layer, list the problems to be solved, and use the appropriate methods to solve them one by one. This study used five creative methods: 5W1H, Causal Layered Analysis (CLA), Synectics, Brainstorming, and mind mapping. Although some parts of these five methods will be similar or overlap, they can be well applied in different aspects when combined with the needs of preanimation work. They can be

Table 4: Mann–Whitney *U* test result.

	Sub-HQ 1	Sub-HQ 2	Sub-HQ 3	Sub-HQ 4
Total *N*	38	38	62	62
Mann–Whitney *U*	84.000	125.000	128.500	143.500
Wilcoxon W	255.000	296.000	758.500	773.500
Test statistic	84.000	125.000	128.500	143.500
Standard error	31.554	29.364	67.162	67.042
Standardized test statistic	−3.042	−1.873	−5.122	−4.907
Asymptotic sig. (2-sided test)	0.002	0.061	0.001	0.001
Exact sig. (2-sided test)	0.004	0.112	—	—

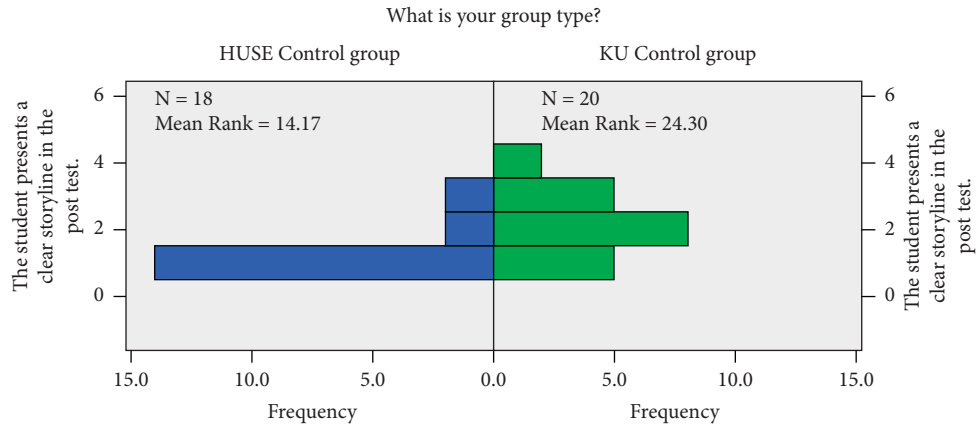


Figure 8: The frequency of the storyline scores after NT in HUSECG and KUCG (*Source.* author 2021).

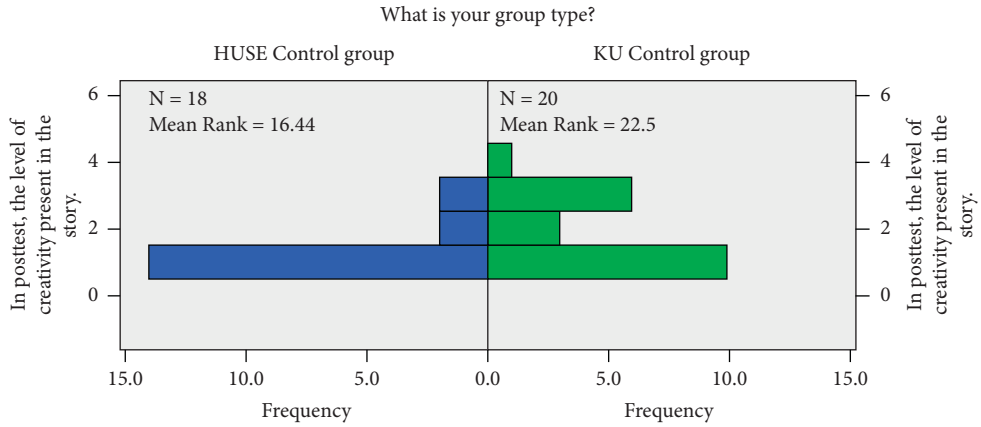


Figure 9: The frequency of the creativity scores after NT in HUSECG and KUCG (*Source.* author 2021).

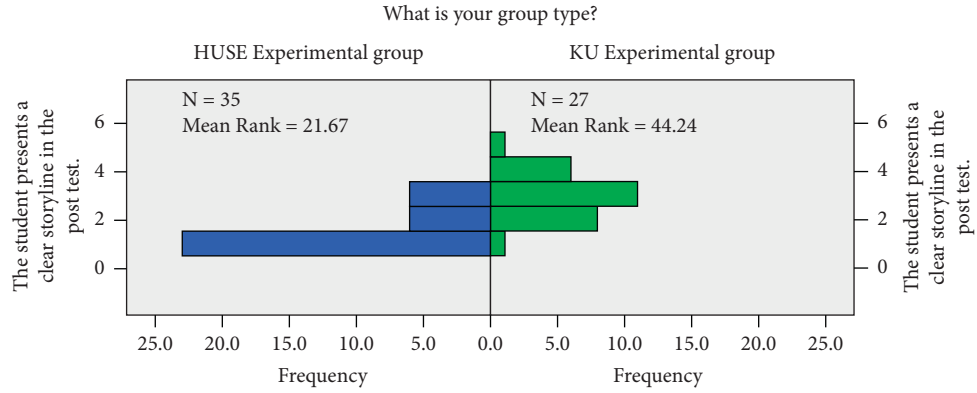


Figure 10: The frequency of the storyline scores after ATS in HUSEEG and KUEG (*Source.* author 2021).

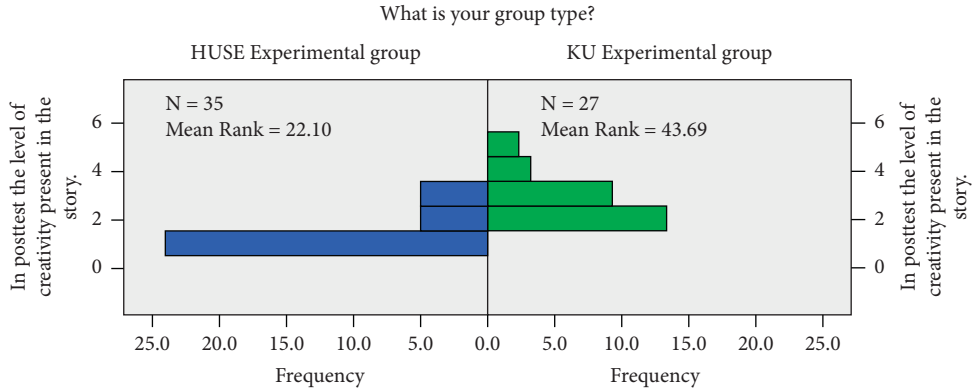


Figure 11: The frequency of the creativity scores after ATS in HUSEEG and KUEG (*Source.* author 2021).

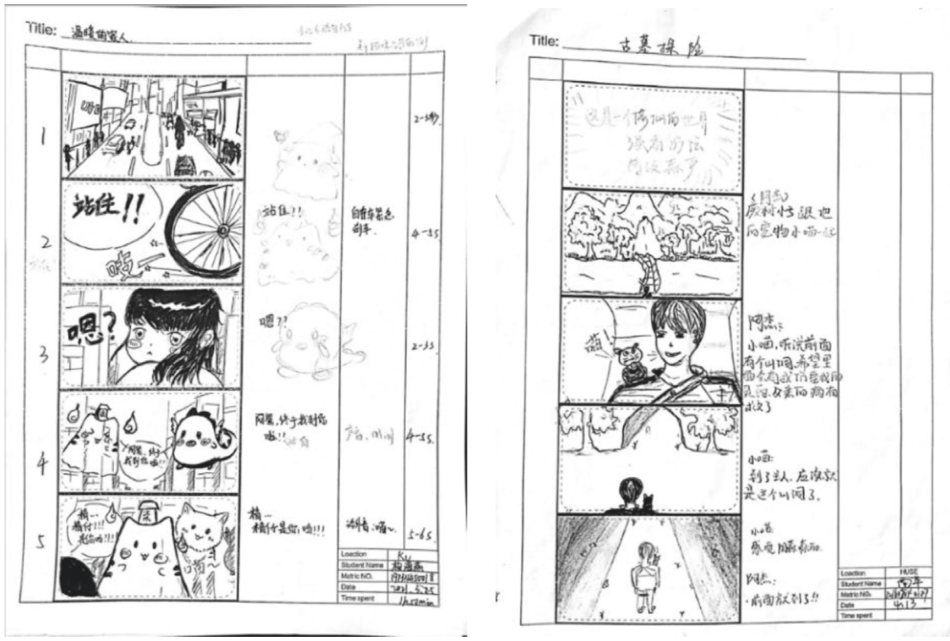
effective in helping students when improving their creative thinking skills. Of course, this attempt is not a perfect set of operating procedures and will not have an immediate effect, and students still need a long break-in period in the process of using it. In the initial implementation of this experiment, we found that while the process of using the ATS gave the students what they were expecting to learn, the ATS still needs to be improved and enhanced.

4.2. Effects of NT on Students. From the Mann–Whitney *U* test results, the students in the control group improved their ability to complete the storyline after the NT. However, they were deficient in helping the students to generate ideas. The normal teaching activities taught the students the basics of animation creation, but not enough to help them generate ideas to meet their needs. It is the opposite of what the industry expects from its talent. The Chinese animation industry is currently in need of creative talent. This is an adjustment to the conventional teaching model. We should no longer focus on teaching the basics and skills as the main goal in animation education. Besides basic knowledge and skills, the cultivation of students' creative thinking also needs to be focused on. Basic knowledge can give students an initial understanding of the profession, and skills can get them to be able to finish the final work on paper or on the computer. But focusing on these two aspects of education can no longer keep pace with the times, and students will only be able to work as skilled craftsmen after they join work-related jobs, lacking the ability to think creatively. Such animation workers can only engage in mindless, repetitive work in the industry, and the possibility of being replaced is very high. It is also not suitable for the development of the industry.

4.3. Students with Different Professional Backgrounds Have Different Performances When Using ATS. Looking at the frequency plots of the two control and experimental groups together, the students of KU digital media art majors performed better in the experiment than those of HUSE digital media technology majors in terms of storyline and creative ability. It shows that although animation majors have many related majors, these majors still have their specialties in nature. Moreover, the curriculum of animation classes is imperfect in these related majors, and students do not receive very comprehensive expertise in the learning process as animation majors do. The entire pre, intermediate, and postcourses are very carefully divided in the animation program. For example, there are special classes for character modeling, scene design, scriptwriting, and storyboard creation. However, in digital media technology and digital media art, these two majors will reduce the corresponding animation classes according to the setting of the major and instead add some courses on interaction design and programming. Although ATS cannot cover the whole animation creation process, it can integrate some of the preproduction work together, which can let students quickly understand what the needs in preproduction animation are the creation and develop students' thinking skills and the practical application of some of the tools used to generate ideas.

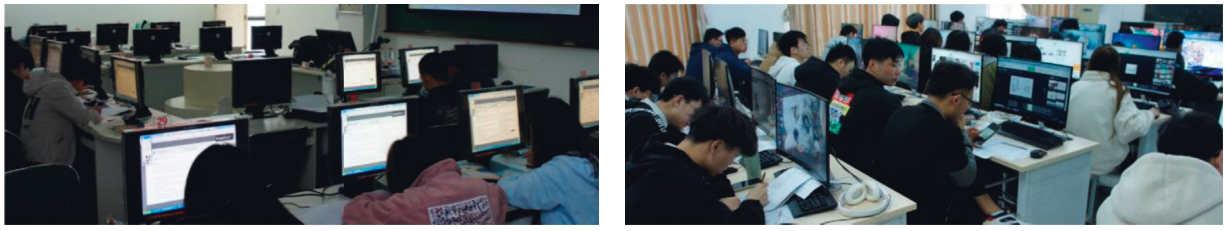
Another point is the students' ability to express themselves on-screen in their posttest work. However, the final evaluation focused only on the students' storyline processing and creative abilities. Moreover, graphic performance was not used as a criterion in the analysis of this experiment. The overall results showed that the digital media art students had an advantage in their expressive skills and techniques (see Figure 12). This factor may have an impact on the students using ATS. Therefore, in the future, when considering different professional backgrounds in using ATS, adjustments, and modifications should be made accordingly. For example, suppose ATS is used in digital media technology majors with a weak foundation in art. In that case, we should consider adding methods to address students' lack of expressive skills in graphics.

As we mentioned earlier, most students have an advantage in art skills. However, there is a lack of storytelling, and the market expects more creative talents so that ATS can solve these two problems positively. The direction of our future research can be affirmed and continued. The work to be done in the future is to improve the system even more, further enhance it in coordinating the operation of the various creative methods, bring out the best in them, and help students with their creative work to the maximum.



(a) (b)

Figure 12: A piece of storyboard from one student (a) in KU and one student (b) in HUSE.



(a) (b)

Figure 13: Photos of the experiment posttest (*Source.* Taken by the author).

4.4. Different Class Seating Arrangements Affect the Way Students Communicate. Since the seating patterns in the experiment were arranged according to the university's existing hardware and equipment conditions, we did not emphasize the influence of this aspect. However, in the actual experiment process, the authors did find that the seating arrangement affected the discussion between groups. For example, the seating arrangement influenced students' discussions during question-and-answer sessions with each other and when students were brainstorming and doing other activities (see Figure 13). Seet Hong An Andrew, Tan Emmanuel, and Rajalingam Preman designed a quasiexperimental study to test the effect of seating arrangement on class engagement in team-based learning. The result presents that the different seat positions can affect students' participation in learning [30]. Of course, after comparing the performance of the participant doors at KU and HUSE during the experiment, the seating layout at KU is more suitable for communication with the teacher and students. However, there are some limitations when students are having group discussions. Therefore, in continued future research, this issue could be included in the preexperimental preparation of the ATS to address the negative impact this issue has on the experiment.

4.5. The Influence of Duration and Frequency of Classes. The scheduling of course lengths is also a newly discovered issue. In our experiment's initial preconception, the two universities' class schedules should be as consistent as possible. However, the different nature of the majors in digital media art and digital media technology led to the difference in setting the class schedule between the two universities. KU's major is digital media art, and the university classifies this major as an art major, so the class schedule is set according to a large art class. See Table 1, where students attend classes three times a week, each of which is close to three hours in length. The long and complete periods of time are very effective for students' learning. There would be a greater fluency for knowledge penetration, and the newly learned knowledge would still be in the memory at the next class. Conversely, HUSE's major is digital media technology, which the university classifies as an engineering major. The class schedule is set up as a regular

minicourse. See Table 1, where students attend classes twice a week for 90 minutes each. Therefore, the number of classes is relatively high, which leads to short lectures and incoherent knowledge for students. This also has a significant impact on student performance during the experiment. Feedback from students after the experiment showed that ATS was relatively popular among students, but most students responded that the class schedule was short. The learning effect would be better if more class time could be scheduled. Unfortunately, this limitation is more challenging to solve in this study. This is because we conducted the experiment in consultation with each university's faculty for that major. Due to the restrictions of the university rules at each university, it was not possible to obtain more classroom access. Time constraints were the biggest obstacle to conducting this experiment, which could also be a reference for future studies.

5. Conclusions

Based on the data analysis, NT affected the storyline scores of the participants in the control groups at both HUSE and KU universities but did not significantly impact the scores of creativities. On the contrary, the analysis of ATS in the experimental groups significantly affected the scores of both measures. However, when looking at the frequency charts, we can see that the overall performance of the KU students is better than that of the HUSE students. Therefore, it can be determined that the professional talent development model impacts the implementation of the ATS experiment, and the method plays a significant role in the group of students from art majors versus those from engineering backgrounds. There are essential guidelines for the subsequent improvement and enhancement of ATS. At the same time, there are certain influences and challenges to implementing ATS due to the complicated unchangeable external factors such as class schedule. For the two schools in the experimental students in the experimental conditions of the different points to sort out: first, the two schools of talent training mode; two, the students' own skills base; three, the class time arrangement way. In response to the above, adjustments should be made. More extended and more complete lecture periods are more conducive to implementing ATS.

The use of ATS is an innovative approach for teaching animation-related subjects. The method improves the teaching and learning of science subjects since students studying science subjects performed poorly in creation. To reduce this ugly trend of student failure in science, using ATS would enable the students to obtain a new method to complete their study and design work since students with different professional backgrounds and talent training directions have very different class schedules. Each class time for art students is longer, more concentrated, and has a short interval period between each lesson, and students remember their knowledge better. In contrast, students with science backgrounds have long class schedules, longer cycles, more fragmented class schedules, and longer intervals between classes. The ATS also needs to be adjusted to more convenience.

From the results of this quasiexperiment, we know that ATS has advantages over NT in meeting the requirements of the animation industry for talent training. It is also concluded that in animation-related majors, different disciplinary backgrounds also impact the implementation of ATS. ATS is carried out more smoothly among students with an artistic foundation. In future research, if the application of ATS needs to be made smoother, the users' professional background and degree of basic knowledge reserve must be investigated. Animation education is crucial as the first gate of talent training in industry development. The situation we are facing now is that the trend of opening animation majors in colleges and universities has gradually stabilized, and there will not be a significant increase in the situation. In this context, the study of animation education is a challenge, and the quality of talents determines the future fate of the profession. This study gives different perspectives on animation higher education and hopes to provide references for other educators.

Data Availability

Since the original data in this study involved the content of intra-group data analysis in the author's Ph.D study, for the purpose of protecting unpublished data, the inter-group data analysis supporting the findings of this study has not been provided.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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