Enhancing Creativity with AIGC-Driven Animated Concept-Map Multimedia Instruction

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Abstract. Among the top ten professions at the highest risk of Artificial Intelligence (AI) substitution, those pertaining to culture and arts exhibit a vulnerability of over 90% in task displacement. Existing design patterns and traditional design education, coupled with an outdated knowledge framework, hinder the development of creative thinking among students due to repetitive and imitative training methods. This study responds to the imperative for a high-quality and intelligent instructional environment in the face of evolving learner demands. It investigates the theoretical framework and development of utilizing Artificial Intelligence Generated Content (AIGC) for multimedia teaching under the ADDIE model, specifically focusing on Animated Concept-Map Multimedia Instructional Representation for enhancing creativity in art design college students. The devised multimedia representation incorporates a digitally animated spatial concept map with a visual guide, aiming to mitigate cognitive load, enhance student engagement, foster cognitive structures, and elevate academic performance. This research contributes to the discourse on innovative pedagogical approaches amid the transformative landscape of AI and its potential impact on the creative industries.

Keywords: Animated concept map; Artificial intelligence generated content; Instructional multimedia; Creativity

1 Introduction

As per projections in OpenAI's artificial intelligence report, there is a looming possibility of AI technology replacing 80% of existing jobs within the next 10-20 years, with the cultural and artistic sectors being the most profoundly impacted. Conventional design patterns and outdated educational approaches, along with an antiquated knowledge framework, impede the cultivation of creativity in art design students by relying on repetitive and imitative training methods [1].

This research addresses the need for a sophisticated and intelligent instructional environment to meet the changing expectations of learners. It explores the theoretical framework and development of employing AIGC for multimedia teaching within the ADDIE model. The focus is specifically on the design and development of animated concept-map multimedia instructional representation to enhance creativity among art design college students. The multimedia representation integrates a digitally animated spatial concept map with a visual guide, aiming to reduce student's cognitive load, increase students' engagement, promote cognitive structures, and improve academic performance. This study contributes to the

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ongoing conversation about innovative pedagogical strategies in response to the transformative influence of AI on the creative industries.

1.1 Art design education

The art design education under investigation in this study pertains to the domain of higher education. Within higher education, the domain of teaching, learning, and research is progressively unfolding amidst a milieu characterized by incessant globalization and heightened levels of competition [2]. They postulated that within academia, a significant proportion of teachers are engaged in both research endeavors and teaching responsibilities. However, a paradox emerges wherein these academics drive research exploration and advancement while their pedagogical practices exhibit a conventional approach, underscored by a limited knowledge foundation [2]. Empirical evidence from the study demonstrates that academic lecturers persist in their adherence to traditional pedagogical approaches characterized by lecture-based teaching methodologies [2][3]. University teachers demonstrate a tendency of limited receptiveness toward embracing novel technologies and rarely incorporate them into their instructional practices [2][3].

1.2 Creativity

Education 4.0 requires students to not only master knowledge and information but also develop skills such as processing information, creativity, and problem-solving. However, questions remain about the methods used by teachers to support creative thinking and problem-solving[4]. In art design education, creativity is a significant role that can play in promoting attempts to deepen understanding [3][5]. Nevertheless, current teaching methods do not fully release the students' creative thinking and analysis abilities, nor do they meet the workplace requirements after graduation [6].

1.3 Animated concept-map multimedia representation

Concept maps serve as visual depictions of information, adopting formats like charts, graphic organizers, tables, flowcharts, Venn Diagrams, timelines, or T-charts. This pedagogical tool proves robust, as it facilitates holistic comprehension. By commencing with overarching concepts, concept maps enable the organization of data through meaningful associations. This holistic perspective elevates the significance of details, rendering memorization more facile. Notably effective in domains with visual constituents or when elucidating interrelationships is paramount, concept maps find utility in information analysis and comparative study [7]. An animated concept map entails the representation of verbal information within a dynamic node-link diagram, which evolves over temporal progression [8]. Drawing on the cognitive theories of Ausubel (1962), Novak postulated that meaningful learning encompasses the assimilation of novel concepts and propositions into pre-existing cognitive structures, thereby underscoring the significance of cognitive framework integration in the learning process [9]. Instructional designers are encouraged to adapt the ACM medium in accordance with empirical evidence and established theories of multimedia learning, thereby emphasizing the importance of aligning instructional design practices with research-based principles and findings [8], which is also suitable for application to art design education. Systematically structured multimedia instructional presentations have been shown to effectively reduce students' cognitive load, bridge conceptual gaps [10]. In addition to that it also can foster the development of creative

thinking, thereby facilitating the generation of novel ideas and promoting creativity among learners. There is a pressing need for a paradigm shift in art design education in response to the evolving dynamics of the field. Moreover, the animated concept-map (ACM) multimedia representation devised in this study, driven by AIGC, holds the potential to catalyze the anticipated paradigm shift in art design education.

2 Materials and methods

2.1 Theoretical framework

This study employs a theoretical framework based on the Taxonomy for Art & Design [11]. It integrates key theories and principles from diverse domains, encompassing art design college students' psychology, including Gardner's theory and triarchic theory, and pedagogy theory, incorporating Bruner's learning theory, Ausubel's meaningful learning theory, and Vygotsky's scaffolding theory. Furthermore, instructional design principles such as CTML and motion graphic design principles are incorporated. This comprehensive framework is employed to guide the design of animated concept-map multimedia representation, aiming to enhance the creativity of art design college students. The presented Figure 1 illustrates the visually conceptualized theoretical framework adopted for the investigation of the studied effects.

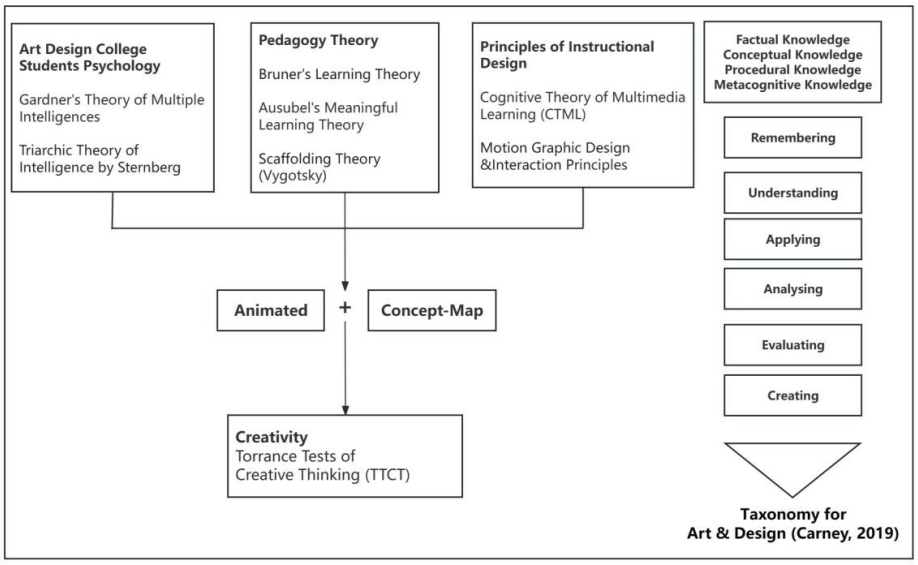

Fig. 1. Theoretical framework.

2.1.1 Design college students psychology

Applying Gardner's Theory of Multiple Intelligences and Sternberg's Triarchic Theory of Intelligence, the study explores art design students' diverse cognitive attributes, offering insights into their psychological profiles and potential strengths.

2.1.2 Principles of instructional design

In pursuit of facilitating art design college students' comprehension and cognitive structuring of theoretical knowledge in art design education, the study implements Mayer's Cognitive Theory of Multimedia Learning (CTML) to guide the design and development of multimedia representations comprising animated visual elements and concept maps. Multimedia learning transpires as learners construct a cognitive schema by assimilating and integrating information from verbal and visual stimuli, developing a cohesive mental representation of the subject matter [12]. The CTML examines the systematic organization of multimedia design by leveraging insights from cognitive strategy research to effectively integrate literal and visual elements, thereby enhancing learners' efficacy in the learning process [13]. As Mautone and Mayer (2001) elucidate, learners demonstrate the ability to discern essential concepts, cognitively structure acquired information, and successfully integrate it with existing knowledge [14][15]. Nevertheless, a significant challenge confronted by multimedia designers lies in effectively introducing novel concepts that are engaging while avoiding cognitive overload, which Mayer and Moreno (2003) define as the state in which the learner's cognitive processing demands surpass their available cognitive capacity [16]. The simultaneous presentation of words and pictures facilitates learners' cognitive integration, enabling the construction of meaningful connections between these elements, thereby fostering the process of knowledge construction [10] and enhancing the comprehension and connection of design concepts.

The prevailing view among media researchers is that the impact of animation on learning is contingent on its specific usage. As a result, the focus has shifted from seeking direct media effects to exploring the circumstances in which animation and other media influence the learning process. Embracing a learner-centred approach, the objective is to comprehend how animation can be effectively employed in alignment with human learning mechanisms [17].

Based on the aforementioned perspectives, the animated representations investigated in this research are summarized as learner-centred graphic motion design, and their underlying principles can be elucidated through interaction design principles. By conscientiously considering creativity, aesthetics, and design ethics, the aforementioned basic principles of movement, hierarchy, balance, direction, symmetry, focus, scale, and rhythm are adeptly presented in the most effective manner [18].

2.1.3 Pedagogy Theory

Bruner's learning theory underscores the active cognitive process of knowledge construction, emphasizing natural inclination, categories, and concepts, along with the importance of simple-to-complex and whole-to-part instruction. Similar to the original Taxonomy, the revised version maintains a hierarchical structure where the six major categories within the cognitive process dimension are arranged in order of increasing complexity: remembering, understanding, applying, analyzing, evaluating, and creating [11].

Ausubel's theory emphasizes meaningful learning, connecting new concepts to existing knowledge for cognitive restructuring. Vygotsky's sociocultural theory informs scaffolding instruction, with the zone of proximal development guiding teachers in providing structured support. The study also integrates elements of constructivism, highlighting the collaborative

and social dimensions of learning for cultivating innovative and service-oriented art design students.

2.2 Methods

This study employs a mixed methods approach, encompassing a literature review in the theoretical framework and incorporating quantitative methods, specifically quasi-experimental research. The research involves 45 art design students enrolled in art design courses at Shanghai Sanda University as participants in their design classes.

The researchers implemented an 8-week animation design course, consisting of four classes per week, each lasting 45 minutes. The study involved a class subjected to pre-test and post-test experimental comparisons, comprising a total of 45 art design students. The experimental group utilized AIGC-Driven Animated Concept-Map Multimedia Instruction for learning. Data collection included student performance assessed through the Torrance Tests of Creative Thinking scale.

2.2.1 The Design Process

The formulation of AIGC-Driven Animated Concept-Map Multimedia Instruction for Chinese art design college students follows a structured process grounded in the ADDIE model, comprising five sequential steps. These steps are elucidated as follows:

Step1:Analysis. The initial step involves identifying the characteristics of the research subject through methods such as literature review, questionnaires, and observations to analyze students in Chinese art design colleges. Utilizing SWOT analysis, this study is detailed across four perspectives: strengths, weaknesses, threats, and opportunities. On the other hand, the selected curriculum's logic, such as the progression of knowledge points from concrete concepts and case studies to providing skills and prompting student reflection, is considered. The learning objectives demonstrate an increasing level of complexity and cognitive demand, spanning from fundamental skills like 'Factual Remembering' to more advanced abilities like 'Metacognitive Creating.' Based on the aforementioned content, keywords are provided to ChatGPT for generating a hierarchical structure diagram of knowledge points. An illustrative instance is demonstrated in Figure 2 below.

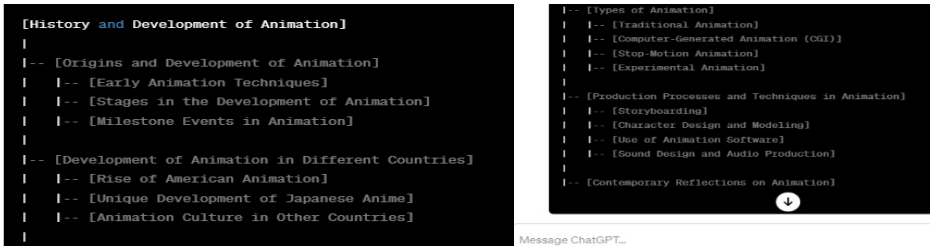

Fig. 2. Exemplifying ChatGPT: course content knowledge generation.

Step 2: Design Prototype.The second phase of this study involves crafting the prototype for multimedia instructional design. The design prototypes are grounded in learner-centered graphic motion design, with their fundamental principles explained through interaction design principles. Emphasizing creativity, aesthetics, and design ethics, the essential principles of

movement, hierarchy, balance, direction, symmetry, focus, scale, and rhythm are thoughtfully incorporated for optimal presentation efficacy. Multimedia technology presents different forms of information to students, and information is no longer a simple superposition but makes an organic, logical connection [19].

Step 3: Development. During the third phase, the researchers will undertake a comprehensive examination of the animated concept-map multimedia instruction's long-term operations, renewal, and development. Figure 3 illustrates the key features.

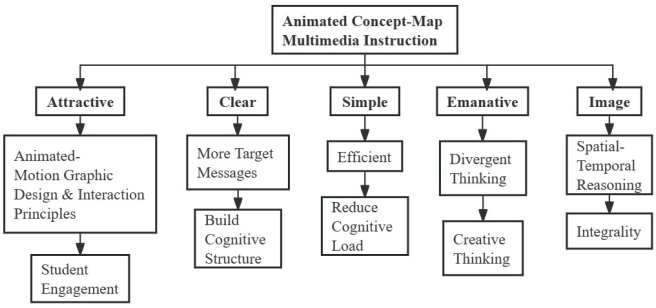

Fig. 3. Key features of animated concept-map multimedia instruction.

Step 4: Implementation. In this stage, effectiveness is evaluated, and any issues in the design and development process are identified. This phase may entail iterative experiments for gathering more comprehensive data and may encounter unexpected situations.

Step 5: Evaluation. Subject matter experts and specialists in multimedia instructional technology undergo evaluation to provide recommendations on the prototype and framework. Furthermore, interviews and questionnaires are conducted to comprehend students' sentiments and opinions following the utilization of this multimedia instruction.

3 Results & Discussion

As indicated in Table 1, the analysis of art design students' scores in academic performance tests (creativity) for the pre-test and post-test experiments reveals an enhancement in their outcomes. The overall score in the post-test experimental data surpassed that of the pre-test data, with a higher proportion of A and A+ grades compared to the pre-test experimental group.

Table 1. The scores in academic performance tests (creativity) for the pre-test and post-test experiment

Scores	pre-test		post-test	
	(n)	*(%)*	*(n)*	*(%)*
A+(90-100)	3	6.7	5	11.1
A(80-89)	14	31	18	40
A-(75-79)	9	20	9	20
B+(70-74)	10	22.2	6	13.3
B(65-69)	4	8.9	4	8.9

Scores	pre-test		post-test	
	(n)	*(%)*	*(n)*	*(%)*
B-(60-64)	3	6.7	3	6.7
C+(55-59)	2	4.4	0	0
Total	45	100	45	100

This study is constrained to Shanghai Sanda University Art Design and Media College, a private institution. Therefore, there is a need for further exploration of other public colleges and universities to enhance the generalizability of the findings. A more comprehensive approach to survey data collection would contribute to a more holistic understanding. To elevate the experimental rigor, it is suggested to implement multi-round pre-test and post-test experiments across various design courses. Establishing experimental hypotheses and utilizing Paired Samples T-Test analysis through SPSSPRO software could provide robust data analysis. Additionally, incorporating diverse creativity assessment tools would contribute to a more rigorous experiment.

4 Conclusions

The outcomes of this study may offer valuable insights for art design college students, providing a learning scaffold to foster creativity. Consequently, when designing and developing AIGC-Driven Animated Concept-Map Multimedia Instruction, careful consideration should be given to guiding students' divergent thinking.

Furthermore, the implementation of AIGC-Driven multimedia instruction has the potential to enhance the multimedia technology proficiency of modern educators. However, the demands of the design system may pose a workload challenge for teachers. Nonetheless, with the support of various AIGC tools, there is a potential for increased efficiency in teachers' work. While the full impact of this approach in instructional design for the evolving educational landscape may take some time to materialize in the next normal, teachers are encouraged to actively embrace and adapt to these changes.

In this study, the objective was to evaluate the effectiveness of AIGC-Driven animated concept-map multimedia instruction in fostering creativity among Chinese art design college students. This research addresses the heightened demand for creative thinking skills among art design students during an era where there is a significant risk of AI substitution in their respective fields.

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