

Designing an artificial intelligence photography course to foster aesthetic sustainability competence in Chinese university students

Yunfei Liu^{1,2}, Peng-Fei Chen^{1*}, Shasha Lei³

¹Chinese International College, Dhurakij Pundit University, Bangkok, 10210, Thailand.

²Wuhu University, Wuhu, 241000, China; blissfulalice@gmail.com (P.F.C.).

³Hubei University of Science and Technology, Xianning, 437000, China.

Abstract: This study designs and implements an Artificial Intelligence photography course aimed at enhancing Chinese university students' aesthetic sustainability within smart classroom environments. Grounded in the principles of Education for Sustainable Development and Connectivism, the course was developed through expert validation and evaluated using a quasi-experimental pretest–posttest design with experimental and control groups. Quantitative data were analyzed using SPSS, while qualitative interview data were examined through NVivo-based thematic coding. Results indicate that the experimental group exhibited significantly greater improvements in overall aesthetic sustainability and its subdimensions, including aesthetic experience, sustainability awareness, and critical thinking, compared with the control group. Additionally, students demonstrated enhanced interdisciplinary collaboration, creative expression, and social responsibility. The AI photography course effectively integrates technology, aesthetics, and sustainability, fostering deeper cognitive engagement and more innovative learning. These findings provide actionable insights for higher-education curriculum reform, suggesting that AI-enhanced art courses can cultivate sustainable thinking and advance innovation-oriented aesthetic education.

Keywords: *Aesthetic sustainability, Artificial intelligence photography course, Connectivism, Smart classroom.*

1. Introduction

Since the beginning of the twenty-first century, *Education for Sustainable Development* (ESD) has increasingly become a central component of global education systems [1]. Through interdisciplinary pedagogy and global citizenship education, students are guided to develop a deeper understanding of global environmental, social, and economic challenges, and are encouraged to become future advocates and leaders of sustainable development [2].

Within this context, university students majoring in photography frequently articulate their perspectives and values through creative practice, addressing pressing social issues such as environmental protection, social justice, and cultural diversity, thereby fostering public reflection and collective action [3]. However, with respect to curriculum goals and assessment criteria, traditional photography education has tended to emphasize formal aesthetics and technical proficiency, while paying relatively limited attention to the principles of sustainable development. In particular, systematic instructional design and evaluation mechanisms remain insufficient for cultivating students' environmental awareness, social responsibility, and long-term aesthetic value judgments, all of which constitute the core dimensions of *aesthetic sustainability* [4].

Accordingly, this study is grounded in the principles of ESD and adopts Connectivism as its theoretical framework. By leveraging smart classroom technologies, it develops an AI-based photography course and employs a mixed-methods design that integrates qualitative curriculum development with quantitative teaching experimentation. The primary objective is to identify the key

factors shaping Chinese university students' aesthetic sustainability and to evaluate the corresponding learning outcomes, thereby providing practical guidance for optimizing photography curricula in Chinese higher education, refining instructional strategies, and advancing the broader goals of ESD.

2. Method

Historically, shifts in social paradigms have led to profound transformations in learning theories. Hersh [5] argues that humanity has transitioned beyond the Information Age into the Post-Information Age, while Downes [6] characterizes the current paradigm as the “Age of Connection.” Against this backdrop, changes in the learning paradigm of photography education have become particularly salient. To address this transformation, *Connectivism* provides a robust theoretical framework. Centered on networked connections, it emphasizes the generation, distribution, and renewal of knowledge across diverse nodes, thereby supporting course design and instructional practices that align with this emerging paradigm.

Connectivism positions learning at the core of learners' cognitive development [7]. Within this framework, the teacher's role shifts from that of a traditional knowledge transmitter to that of a facilitator who designs and supports a structured learning network encompassing communication, assessment, feedback, observation, information presentation, and activity organization. This transformation enables students to autonomously select, connect, and integrate learning resources [8] as illustrated in Figure 1.

In this study, the principles of Connectivism were applied to design an AI-based photography course. The course design transcends the conventional unidirectional transmission of knowledge within the classroom, extending into a broader, open, and networked learning environment. By leveraging connections across multi-level network nodes, the course content and learning ecosystem are structured to stimulate students' active participation in knowledge creation and exchange. Through diverse and flexible learning pathways, the course ultimately aims to foster the development of aesthetic sustainability. The conceptual framework of this study is presented in Figure 2.

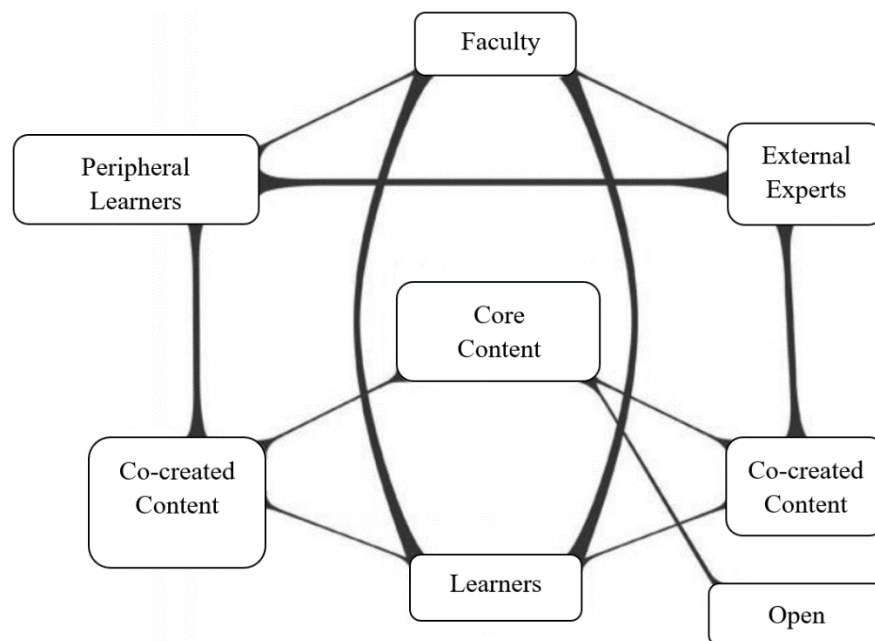


Figure 1.
Course Learning Model.

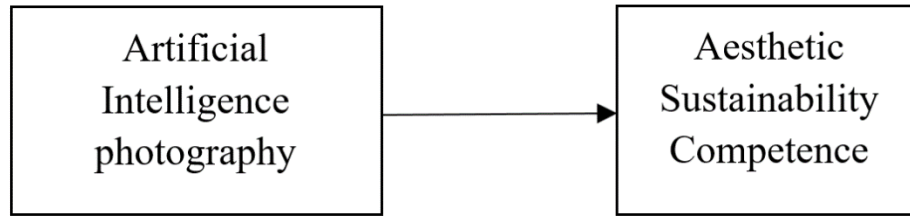


Figure 2.
Conceptual framework.

3. Methodology

To enhance university students' aesthetic sustainability and evaluate the instructional effectiveness of the AI-based photography course, this study was implemented in two distinct phases.

In the first phase, the theoretical framework of Connectivism was critically examined, and an extensive review of relevant literature was conducted to determine the course objectives and establish the competency indicators for aesthetic sustainability. Building upon this foundation, the outlines for Units U1–U4, the corresponding instructional activities, and the course evaluation system were systematically designed. These efforts culminated in the development of a comprehensive instructional framework, including both the overall teaching plan and detailed lesson plans.

Subsequently, six domain experts were invited to evaluate the course structure and instructional design. Their feedback was used to revise, refine, and optimize the course content to ensure pedagogical rigor and contextual relevance. The conceptual framework for the development of the AI-based photography course is illustrated in Figure 3.

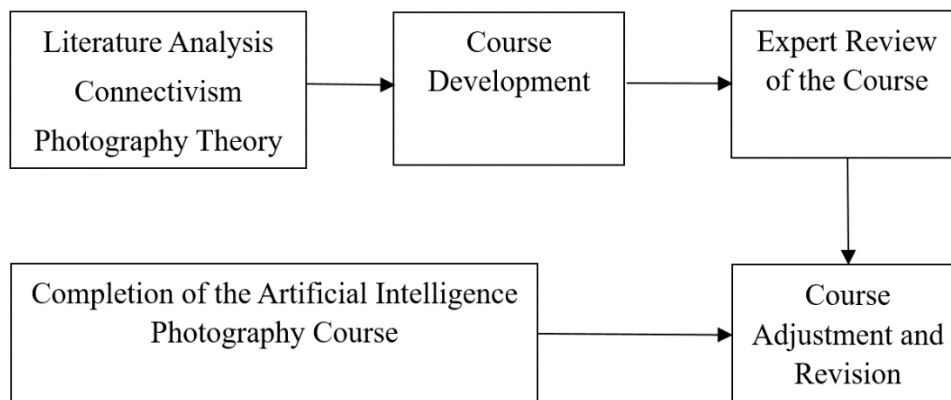


Figure 3.
Research Framework.

Artificial Intelligence Photography Course Development.

3.1. Expert Review

The indicator system for *aesthetic sustainability* within the AI-based photography course was developed on the basis of the *Aesthetic Sustainability Scale* (ASS) constructed in this study. The development process integrated the core elements of existing measurement instruments and extended them to reflect the unique characteristics of the AI photography curriculum. By systematically reviewing and synthesizing measurement tools related to the three fundamental dimensions of aesthetic experience, sustainability awareness, and critical thinking the study refined and adapted scale items to construct a comprehensive and context-appropriate ASS. Specifically, the scale design drew upon Chang [9] *Student Aesthetic Experience Scale*, Gericke et al. [10] *Sustainability Consciousness Questionnaire*, and

the Chinese *Critical Thinking Scale* developed by Hou et al. [11]. The resulting instrument provides a systematic and theoretically grounded approach to assessing university students' aesthetic sustainability.

The ASS employs a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) comprising 32 items distributed across eight core dimensions. To ensure the instrument's reliability and validity, a pilot study was conducted, during which item analysis, factor analysis, and reliability testing were performed. The results confirmed that the ASS functions as a scientifically robust and effective measurement tool for subsequent research. Within this framework, a preliminary draft of the AI photography course structure was also developed.

To further validate the course content and competency indicator system, six domain experts were invited to conduct a content validity evaluation. Their feedback directly informed the refinement of the indicator system and supported the development of a Connectivism-based AI photography curriculum. Expert selection criteria included possession of a doctoral degree or higher; specialization in photography, film and television production, visual communication design, or fine arts; attainment of at least a mid-level professional title; and more than five years of teaching experience. The details of the expert panel are presented in Table 1.

Table 1.
Experts' Background Information.

Expert	Gender	Degree	Major	Title	Teaching Experience	Institution
1	Male	Ph.D.	Visual Communication Design	Professor	19 years	Higher Education Institution
2	Female	Ph.D.	Photography	Professor	17 years	Higher Education Institution
3	Male	Ph.D.	Education	Professor	16 years	Higher Education Institution
4	Female	Ph.D.	Educational Technology	Associate Professor	11 years	Higher Education Institution
5	Female	Ph.D.	Photography	Associate Professor	7 years	Higher Education Institution
6	Male	Ph.D.	Visual Communication Design	Associate Professor	6 years	Higher Education Institution

Six university experts conducted a comprehensive evaluation of the three-tier indicator system for the course objectives. The panel unanimously agreed that the first-level indicators *Aesthetic Experience*, *Sustainability Awareness*, and *Critical Thinking*, together with their associated second-level indicators, exhibited a coherent logical hierarchy and a theoretically sound framework. Most of the experts' feedback centered on refining the third-level indicators.

Experts 1 and 3 observed that the original indicators A1.3 ("ability to analyze the aesthetic characteristics of different styles of artworks using sensory perception") and A1.4 ("ability to experience aesthetics through multiple senses such as vision and hearing") both focused on sensory experience, resulting in semantic redundancy. They recommended revising one of the indicators to enhance conceptual clarity. In response, Expert 1 suggested modifying A1.3 to "ability to compare and analyze the aesthetic characteristics of different artistic styles."

Experts 1 and 5 further pointed out that the original B1.3 ("ability to demonstrate support for environmental protection actions and contributions") predominantly reflected the internalization of concepts rather than actionable engagement. They advised revising the indicator to emphasize concrete practices. Accordingly, Expert 1 proposed refining B1.3 to "ability to promote environmental protection concepts through public art projects or social initiatives (e.g., environmental-themed exhibitions, community campaigns on waste sorting)."

Expert 2 argued that the original formulation of B3.4 ("ability to evaluate the balance between short-term economic benefits and long-term sustainable development goals in the creative process") contained ambiguous terminology, particularly regarding the notion of "balance," and lacked measurable criteria for "short-term" and

“long-term” outcomes, which could lead to subjective interpretations. He therefore recommended revising B3.4 to “ability to comprehensively evaluate the environmental impact and economic benefits of art projects, balancing short-term gains with long-term sustainability.”

Based on these recommendations, all consistent with the pedagogical aims of the course indicators A1.3, B1.3, and B3.4 were revised accordingly. The expert panel unanimously endorsed the revised version, with no further changes proposed. Thus, the updated three-tier indicator system provides an authoritative and theoretically grounded foundation for course implementation.

4. Results

4.1. Course Objectives of the Connectivism-Based AI Photography Course

The learning objectives were designed for university students majoring in photography who had already acquired basic knowledge and skills in the field. Accordingly, eight third-level competency indicators were selected as the instructional objectives of the course, aiming to enhance students' advanced photography skills, as presented in Table 2.

Table 2.
Teaching Objectives of the Artificial Intelligence Photography Course.

Core Competencies	Capacity Indicators
A. Aesthetic Experience Competence	A1.1 Able to perceive the existence of beauty in natural landscapes, works of art, and everyday life.
	A2.1 Able to analyze aesthetic elements in artistic works.
	A3.1 Able to reflect on transforming aesthetic experiences into personal aesthetic appreciation.
B. Sustainable Development Awareness Competence	B1.3 Able to promote environmental protection concepts through public art projects or social initiatives (e.g., environmental-themed exhibitions, community waste-sorting advocacy).
	B2.4 Able to practice behaviors that foster social equity and sustainable development in daily life.
	B3.4 Able to fully consider both the environmental impact and economic benefits of art projects, balancing short-term gains with long-term sustainability.
C. Competence in Critical Thinking	C1.4 Able to analyze the essence of artistic works and the intention behind their creation.
	C2.4 Able to evaluate one's own artistic creations and aesthetic decision-making ability.

4.2. Development of the AI Photography Course

The instructional unit design of this course is grounded in Connectivist learning theory, emphasizing networked learning, encouraging students' autonomous exploration, and fully leveraging the potential of AI tools in teaching. The course is organized into four units, with the overarching aim of fostering students' aesthetic sustainability. Detailed information is presented in Table 3.

4.2.1. Content of the Unit

Table 3.

AI Photography Course Institutional Framework.

Units	Teaching objectives	Class time (hours)	Content (Lesson)
U1. Photography Aesthetics and AI Cognition	A1.1 A2.1 C2.4	8	1. Theories of Photographic Aesthetics and Artwork Appreciation 2. Applications and Values of AI in Contemporary Photography 3. Cultivating the Ability of AI-Enabled Photographic Creation
U2. Smart Photography and AI Image Analysis	B1.3 B2.4 B3.4 C1.4	8	1. AI-Based Image Generation for Thematic Photography 2. AI-Based Image Analysis for Thematic Photography 3. Collaborative Thematic Photography Project
U3. Image Editing and Style Transfer Technology	A2.1 A3.1 B3.4 C1.4	8	1. AI Image Editing Technology 2. AI Style Transfer Technology 3. Collaborative Thematic Photography Project
U4. Interdisciplinary Collaboration and Creative Exhibition	A3.1 C1.4 C2.4	8	1. Exhibition Design of Achievements 2. Public Communication and Social Interaction Design

U1. Photography Aesthetics and AI Cognition: This unit aims to enable students to develop a systematic understanding of photography aesthetics and artificial intelligence through interdisciplinary integration. It focuses on exploring both traditional and contemporary theories of photographic aesthetics, understanding the role of AI in the evolution of visual language, and comparing traditional and AI-driven artistic thinking through case studies. The unit also emphasizes cultivating students' ability to transform technology into a driving force for creative expression.

U2. Smart Photography and AI Image Analysis: This unit focuses on ecological and environmental themes, emphasizing the application of AI in image generation and analysis. Students are guided in using drones and generative models to create and restore ecological imagery, while employing deep learning and CLIP technologies to analyze the ecological and aesthetic value of images. Through interdisciplinary team collaboration, the unit aims to integrate scientific rigor, artistic expression, and social communicative impact.

U3. Image Editing and Style Transfer Techniques: This unit highlights the advanced applications of AI in post-processing, including both AI-based image editing and style transfer methods. It emphasizes the integration of technology with social issues, guiding students in achieving the fusion of artistic style and thematic narrative through parameter adjustment and critical validation. Within interdisciplinary projects, the unit further enhances students' responsiveness to the Sustainable Development Goals.

U4. Interdisciplinary Collaboration and Creative Exhibition: This unit centers on exhibition outcomes and public communication, aimed at cultivating students' competencies in exhibition planning, visual presentation, and cross-disciplinary collaboration. It incorporates AI design tools and AR/VR technologies to enhance exhibition interactivity, transforming creative outputs into resources for community education and policy advocacy through public dissemination and social engagement.

4.2.2. Teaching Methods

Downes [6] argues that the pedagogy of Connectivism can be summarized as follows: teaching involves demonstration and modeling, while learning involves practice and reflection. Knowledge is not simply transferred from one entity to another; rather, it is produced and developed through interactions among entities within a network, as well as through interactions with entities in the real world. Demonstration and modeling aim to activate such interactions, while the growth of the network

depends on individuals' practice and reflection [6]. The ultimate goal of learning is recognition, that is, the ability to identify connections between relevant phenomena or sources of information and, even in rapidly changing environments, to continuously update and revise knowledge in response to emerging developments [12]. For this reason, Connectivism emphasizes building connections rather than presenting content in its entirety [13].

Building upon a systematic review and synthesis of the aforementioned research findings, this study integrates the core principles of Connectivism to design a teaching methodology grounded in Connectivist learning theory. The methodology consists of seven steps, as presented in Table 4.

Table 4.
Connectivist Teaching Method.

Step	Name	Objective
A.	Defining Learning Objectives	Identifying Learning Needs
		Setting Goal Orientation
		Ensuring Digital Adaptation
B.	Constructing Learning Networks	Designing Knowledge Nodes
		Recommending Resources
		Establishing Connection Channels
Step	Name	Objective
C.	Guiding Information Filtering	Cultivating Filtering Ability
		Constructing Knowledge Associations
		Supporting Tool Utilization
D.	Stimulating Collaboration and Participation	Forming Learning Communities
		Real-Time Interaction
		Stimulating Participation
E.	Supporting Autonomous Learning and Updating	Encouraging Autonomous Exploration
		Dynamically Updating Knowledge
		Reflecting and Improving
F.	Evaluation and Feedback	Network-Based Evaluation
		Providing Multidimensional Feedback
		Focusing on Growth Orientation
G.	Strengthening Knowledge Transfer and Practice	Promoting Cross-Domain Applications
		Designing Contextualized Tasks

4.2.3. Course Evaluation Methods

Based on Connectivist learning theory, this study develops a dynamic and multidimensional teaching evaluation system. By integrating both formative and summative assessments, the system comprehensively monitors students' competence development in knowledge network construction, collaborative learning, and public value dissemination. The evaluation system is implemented throughout the course, focusing not only on the real-time feedback of individual learning trajectories but also on validating the outcomes of group collaboration and social impact. Detailed information is presented in Table 5.

Table 5.
Course Evaluation System.

Units	Assessment Methods	Content
U1.	Formative Assessment	Classroom Interaction Portfolio
		Technology Ethics Debate
		Creative Journal
	Summative Assessment	AI Photography Portfolio Defense Meeting
U2.	Formative Assessment	Ecological Data Collection Log
		AI Model Training Report
	Summative Assessment	Thematic (Ecological and Social) Photography Portfolio
		Team Collaboration Assessment
U3.	Formative Assessment	Technical Practice Log
		Ethical Reflection Report
		Economic Feasibility Analysis
	Summative Assessment	Thematic (Ecological and Social) Photography Portfolio Team Collaboration Assessment
Units	Assessment Methods	Content
U4.	Formative Assessment	Exhibition Planning Proposal
		Public Communication Experiment
		Collaborative Development Log
	Summative Assessment	Public Exhibition Implementation Sustainability Assessment

5. Conclusion and Recommendation

The AI Photography Course was piloted with one class of 62 sophomore arts students over eight three-hour sessions within one month. The course design was first tested for feasibility, followed by interviews with 10 students to capture their learning feedback. The interview data revealed that students shifted from focusing on formal elements such as composition, color, atmosphere, and narrative to engaging in deeper reflection on the ecological meanings, social values, and cultural responsibilities embedded in their work. This shift indicates that the course proved significant in facilitating the transition from sensuous experience to rational reflection. At the same time, the course substantially reshaped students' learning approaches, fostering their capacity for interdisciplinary knowledge integration. Students developed a learning cycle centered on AI-enabled immediate feedback, iterative refinement, and self-directed inquiry, while actively linking photographic learning with knowledge from environmental science, economics, and public communication.

The course also advanced students' development in artistic innovation and social responsibility. Participants demonstrated stronger innovation awareness and heightened concern for social issues. They proactively explored cross-media and cross-disciplinary modes of expression and incorporated themes such as environmental protection, consumption, and public communication into their work. In doing so, they achieved a unity of aesthetic and social value in artistic creation.

Grounded in Connectivism, this study underscores the potential of connection-based learning models, including collaborative and personalized learning in photography education, promoting both deep learning and sustainable aesthetic expression. Through curriculum design and pedagogical innovation, it explores ways to create a more interactive and immersive learning environment. Beyond its immediate context, this research offers valuable theoretical and practical insights for the reform of photography curricula, contributing to the application of educational technology and AI in arts education while cultivating innovative talents equipped to meet the demands of the new era.

Institutional Review Board Statement:

This study involving human participants was reviewed and approved by the Human Research Ethics Committee, Dhurakij Pundit University (DPUHREC) (Approval No. DPUHREC004/68EX). The research was conducted in accordance with institutional, national, and international ethical standards

(e.g., the Declaration of Helsinki). All participants were fully informed of the study's purpose and procedures and provided written informed consent. Participant anonymity and data confidentiality were maintained.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Copyright:

© 2025 by the authors. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

References

- [1] E. Mokski, W. Leal Filho, S. Sehnem, and J. B. S. O. d. Andrade Guerra, "Education for sustainable development in higher education institutions: An approach for effective interdisciplinarity," *International Journal of Sustainability in Higher Education*, vol. 24, no. 1, pp. 96-117, 2023. <https://doi.org/10.1108/IJSHE-07-2021-0306>
- [2] M. Saini, E. Sengupta, M. Singh, H. Singh, and J. Singh, "Sustainable development goal for quality education (SDG 4): A study on SDG 4 to extract the pattern of association among the indicators of SDG 4 employing a genetic algorithm," *Education and Information Technologies*, vol. 28, no. 2, pp. 2031-2069, 2023. <https://doi.org/10.1007/s10639-022-11265-4>
- [3] Z. M. Huang and H. Cockayne, "Searching for belonging: learning from students' photographs about their higher education experiences," *London Review of Education*, vol. 21, no. 1, p. 27, 2023. <https://doi.org/10.14324/LRE.21.1.27>
- [4] S. Y. Peng and X. Wan, "Teaching reform and practical exploration of college photography courses," *Weekly Academic Journal*, vol. 16, pp. 17-20, 2025.
- [5] W. Hersh, "Search still matters: information retrieval in the era of generative AI," *Journal of the American Medical Informatics Association*, vol. 31, no. 9, pp. 2159-2161, 2024. <https://doi.org/10.1093/jamia/ocae014>
- [6] S. Downes, "Connectivism," *Asian Journal of Distance Education*, vol. 17, no. 1, pp. 58-87, 2022.
- [7] G. Siemens, "Connectivism: Learning as network-creation," *ASTD Learning News*, vol. 10, no. 1, pp. 1-28, 2005.
- [8] G. Siemens and P. Tittenberger, *Handbook of emerging technologies for learning*. Winnipeg, Canada: University of Manitoba, 2009.
- [9] Y. C. Chang, "Construction on students' aesthetics experience scale," *International Journal of Organizational Innovation*, vol. 10, no. 1, pp. 110-130, 2017.
- [10] N. Gericke, J. Boeve-de Pauw, T. Berglund, and D. Olsson, "The sustainability consciousness questionnaire: The theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development," *Sustainable Development*, vol. 27, no. 1, pp. 35-49, 2019. <https://doi.org/10.1002/sd.1859>
- [11] Y. Hou, Q. Li, and H. Li, "Chinese critical thinking: Structure and measurement," *Acta Scientiarum Naturalium Universitatis Pekinensis*, vol. 58, no. 2, pp. 383-390, 2022. <https://doi.org/10.13209/j.0479-8023.2022.001>
- [12] W. Al-Maawali, "Integrating critical thinking into digital connectivism theory: Omani pre-service teacher development," *Language Teaching Research Quarterly*, vol. 32, pp. 1-15, 2022. <https://doi.org/10.32038/ltrq.2022.32.01>
- [13] F. Corbett and E. Spinello, "Connectivism and leadership: Harnessing a learning theory for the digital age to redefine leadership in the twenty-first century," *Heliyon*, vol. 6, no. 1, p. e03250, 2020. <https://doi.org/10.1016/j.heliyon.2020.e03250>