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RESEARCH ARTICLE

The Impact of Art College Students' Innovation Learning Ability Under STEAM Education

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ABSTRACT

STEAM education, as an education model to train future comprehensive talents, not only challenges the traditional education, but also puts forward on the new requirements for students' learning ability. As it empowers people to create and solve issues in their daily lives, the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) education has a significant influence on generating creative students. Problem-solving ability, innovation ability, cooperation ability and autonomous learning ability are the popular student's learning ability to discussed emphatically by educators. Among these abilities, innovation ability is the most topical, and it is more in line with the development of society. Under the theory of Self-efficacy, Learning Engagement, and Creative Performance, this study aims to investigate the impacted elements of the art college students' innovation learning ability under STEAM education system; and to analyze the art college students' perspectives of innovation learning ability under STEAM education system at a university in China. It adopts interview method with 6 samples at Shenyang Normal University in Liaoning Province, China. Through the systematic study of STEAM education concept, the findings indicated that creative self-efficacy, learning engagement and creative performance are the related elements with innovation learning ability. The more cognitive, emotional, and behavioral inputs students get and the more demanding efforts they put into creative activities, the greater the influence on students' creative performance. In addition, the art college students' perspectives of innovation learning ability under STEAM education system are positive.

Contribution/Originality: This study provides important evidence and basis for the future development of STEAM education. It contributes the study of art college students' perspectives of innovation learning ability under STEAM education system.

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1. Introduction

The focus of art and design talent training in the twenty-first century has shifted to developing creatively expressive abilities in light of the emergence of the knowledge economy (Shen et al., 2021). When coming up with new concepts, finding solutions to novel challenges, and producing new work, learners must adapt an increasing amount of multidisciplinary knowledge and abilities (He et al., 2019). Nonetheless, the majority of art and design majors at various Chinese universities are discipline-centered, emphasizing the acquisition of disciplinary knowledge above the quality of the learning process. Thus, art students at higher education institutions will not be able to use what they have learned to solve real-world issues if theories cannot be put into practice. They thus pick up pointless knowledge (Jia et al., 2021). A curriculum that integrates scientific instruction with hands-on learning not only supports the growth of art professionals but also enables students in higher education institutions express themselves more creatively (de Vries, 2021). Since art has been demonstrated by several academics to play a significant role in promoting STEM, Science, Technology, Engineering, Arts, and Mathematics (STEAM) education incorporates art into already-existing STEM education. It encourages comprehension from an ever-widening range of viewpoints, establishing connections between disciplines and encouraging the development of creative expression, original thought, and problem-solving abilities (Sanz-Camarero et al., 2023).

However, practitioners are unable to implement an effective approach to STEAM education in China due to the lack of specific strategies in related research, the ambiguity between STEAM education and art and design education, and the tendency for the development of creative expression skills to impede the development of teaching and learning (Nong et al., 2022). This has an impact on how teaching and learning are developed as well as the achievement of higher education institutions' ultimate objective, which is to produce artistic and design talent for regional cultural education. Establishing an efficient STEAM education strategy to foster students' capacity for creative expression is essential to the successful application and implementation of STEAM pedagogy in art classrooms. Therefore, in order to investigate the impacted elements of the art college student's innovation learning ability under STEAM education system; and to analyze the art college students' perspectives of innovation learning ability under STEAM education system at a university in China, this study uses interview on the conversations of 6 interviewees to receive the results.

2. Literature Review

Huo et al. (2020) state that, instead of merely forcing traditional culture into the STEAM curriculum, STEAM education in China places an emphasis on the organic integration of multidisciplinary knowledge and methods of thinking directed towards legacy culture. The highly interwoven field of art and design necessitates the resolution of several intricate issues. Sha et al. (2021) state that, in China, problem solving, optimization, and design are closely associated with technology and engineering in STEAM education. Colleges and universities have many resources for education modernization construction to benefit more college students from the achievements of China's education informatization construction, strengthen their deep learning, and promote the generation of independent learning and creative thinking. For the cultivation of innovation ability, Yue et al. (2021) pointed out that there are mainly two kinds: school training, which is the cornerstone of innovation ability, and social training, which is the condition of innovation ability, both of which are indispensable. Moreover, Wang and

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Wang (2023) narrate that, for China's educational conditions, it is very important for colleges and universities to improve the quality and efficiency of students' innovative ability and to reconstruct and upgrade it.

Bandura and Adams (1977) was the first to propose in 1977 that self-efficacy is a crucial component that influences an individual's learning process and that it has a special and crucial function in every endeavor. Meanwhile, self-efficacy can affect students' learning behavior, and then affect students' learning motivation and achievement. Tierney and Farmer (2002) established the notion of creative self-efficacy, which combines self-efficacy with creative performance. In addition, Farmer et al. (2022) explain that, when faced with difficulties or barriers, those who have a high creative self-efficacy are able to produce a strong intrinsic motivation. On the other hand, those who have poor creative self-efficacy are more prone to give up or shun creative endeavors (Schunk & DiBenedetto, 2021).

The learning engagement idea was initially put out by Astin (1986) in 1986. Petillion and McNeil (2020), Dong et al. (2020) and Wu et al. (2020) have the same opinion is that, according to their perspective, learning engagement is the time and effort students devote to tasks that have educational objectives as well as the way they think, feel, and act while they are learning. Individuals in the learning process naturally show a psychological state known as learning engagement. Affective and behavioral learning inputs (Kariippanon et al., 2019) are the two fundamental components of participants' motivation and learning dynamics, which are reflected in varying degrees by different learning inputs (Doo & Bonk, 2020). Li et al. (2022) agree with Doo and Bonk (2020), and explain that these two factors pertain to the learners' emotional experience quality and their ability to initiate and engage in constructive actions during learning activities. According to Liu et al. (2021), affective engagement refers to the psychological states that students experience during the learning process and is a manifestation of their attitudes and emotional responses to the subject matter, such as enjoyment (Halverson & Graham, 2019), interest (Smiderle et al., 2020), and satisfaction (El-Sayad et al., 2021). When faced with challenges or failure, students who are engaged in their learning maintain a consistent state of conduct. According to Kariippanon et al. (2019), learning engagement encompasses not only affective and behavioral aspects but also cognitive orientation. Moreover, Zheng et al. (2020) narrate that, cognitive orientation pertains to learners' comprehension of learning and the level of mental exertion they must undertake to accomplish their learning objectives. Same as Gkintoni and Dimakos (2022), they believe that it has also been demonstrated to use cognitive methods to control the learning process.

Creative expression was first defined by Guilford (1967) and describes a person's innate ability to come up with and offer fresh concepts, solutions, and other creative endeavors in a certain field or sociocultural setting (Amabile, 1983; Wang et al., 2023). According to Wei et al. (2023), creative expression is further described as the application of all existing knowledge towards a particular goal in order to generate an original, distinctive, socially or individually meaningful thinking output, which may take the shape of a novel good, method, or concept. Technology can also refer to novel theories, thoughts, or ideas. The purpose of the study is to explore the impacted factors of the art college student's innovation learning ability under STEAM education system. Therefore, there are two research objectives of the study, they are:

i. To investigate the impacted elements of the art college student's innovation learning ability under STEAM education system.

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ii. To analyze the art college students' perspectives of innovation learning ability under STEAM education system at a university in China.

3. Research Methods

Based on the research objectives, this study adopts semi-structured interview as the method to investigated the purpose. The researcher purposefully selects 6 art education majored students from Shenyang Normal University in China as the interviewees. Moreover, as Guest et al. (2006), Bekele and Ago (2022) cited that thinking of heterogeneity while taking sample, 6-8 interviews are enough for a homogeneous sample. In this study, the researcher purposeful selected 6 students from different grade levels, age, and gender. In order to evenly distribute the samples to all factors, the researcher select three female students and 3 male students; also, the age is from 18-22, involve different levels of ages. In addition, freshman and sophomore students have less art courses under STEAM education than junior and senior students, they have less experiences in this situation. Therefore, 1 freshman, 1 sophomore, 2 juniors, and 2 seniors attend this interview. the demographic information of the interviewees shows as Table 1.

Table 1: Demographic Information of Interviewees

Interviewee Code	Gender	Grade	Age
I 1	Female	Freshman	18
I 2	Male	Sophomore	19
I 3	Female	Junior	20
I 4	Male	Junior	21
I 5	Female	Senior	21
I 6	Male	Senior	22

The process of the study is to send the participation announcement to the participants first, and select the appropriate interviewees from the group who agrees to participate in the project. Second, set an interview time with the interviewees and record it with Tencent Meeting Application. Third, organize all interviewees' materials and make written records. Finally, according to the theory, analyzed the results.

In order to facilitate the implementation of the interview, this paper does a question guide. The factors of the questions are adopted from "The Cultivation of Innovative ability of College Students Based on STEAM Education Concept" by Yue et al. (2021). In the article, it provides the inspiration of STEAM education concept in the cultivation of college students' innovative ability: learning the efficacy of self-confidence, comprehensive learning engagement, and creative and innovative performance. Thus, the questions are designed around these three factors. After this, the question guide was evaluated by three experts from related fields, all of them are full-time art professors with STEAM education experiences. After their suggestions and modifications, the question guide is as follows:

i. How do you understand self-efficiency in STEAM education? (Q1)
ii. Is learning engagement difficult for you in STEAM education? (Q2)
iii. How do you feel when you need creative performance in STEAM class? (Q3)
iv. What's your perspective about STEAM courses? (Q4)
v. Do you think innovation learning ability is necessary to have while you are in STEAM courses? (Q5)

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The coding for data analysis is the combination of question numbers and interviewees code numbers, for example, Q1I1 is for Question 1 and Interviewee 1.

4. Results

4.1. The Impacted Elements of the Art College Student's Innovation Learning Ability under STEAM Education System

Innovation is the source of social development. Only by treating practical problems with innovative thinking, we can find the root of problems from a new perspective, transcend the boundaries of fixed thinking, break the routine, and solve problems (Meng, 2023). Innovation is the source of social development. Only by treating practical problems with innovative thinking, can we find the root of problems from a new perspective, transcend the boundaries of fixed thinking, break the routine, and solve problems. Improving students' innovative ability and cultivating students' unique thinking are the basis of ensuring their own learning ability (Nong et al., 2022). In innovative thinking, students' own input, the embodiment of self-efficacy, and creative performance are the most authentic ways of expression, and complement each other. Students' self-efficacy and learning engagement are the prerequisite and driving force of creative performance. The better the students' creative performance, the more confident they will be and the more engaged they will be in learning. In the interview, the three most influential factors of the interviewees' answers are: self-efficacy, learning engagement, and creative performance. The following analysis focuses on the three influencing factors.

4.2. Self-efficacy

To answer Q1, which is the question about the perspective of self-efficiency, Q1I1 gives the idea of "*Innovation and creativity in the STEAM classroom are always flowing. I always enjoy the creative process. In the art design class, our desire for interdisciplinary comprehensive knowledge enables us to devote ourselves to learning, have good ideas and then have good creative performance, and then I will gain confidence.*" It confirms that self-efficacy is the embodiment of learning self-confidence and the basis of learning strategy cultivation and training. Successful experiences increase self-efficacy, and repeated failures decrease self-efficacy. Successful experiences increase self-efficacy, and repeated failures decrease self-efficacy. At the same time, interest can make people more engaged and get better grades, thus promoting the growth of ability, which forms a virtuous circle. In addition, Q1I2 reports that "*I experienced the embodiment of self-worth in the STEAM class. I have always been interested in interdisciplinary courses, in which I often feel that I have more control over knowledge than others. I was always the one leading the group. For this performance, I am very satisfied with myself, and I have more in-depth supervision of my study*." It can be seen that in a continuous learning process, students self-supervise the learning progress, complete the production of the works, and make self-evaluation of the works to produce self-efficacy. This is metacognition of self-learning observation, regulation, control, reinforcement of self-regulation. It ensures that learners are able to adopt solutions and approaches closer to their goals. Subsequently, Q1I4 claims that "*I really enjoyed the STEAM course, which I did not experienced in other courses. I was always disappointed with the regular course, because my grades were not very good. However, the STEAM class made me feel confident, my design and problem-solving methods were always recognized, teachers and team members often praised me, I felt very happy, and I would be more involved when creating again.*" This shows that STEAM education has a lot of hands-on activities based on display scenarios. These

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activities are very real, the tools and materials required are real, mobilize the practical ability, emphasize the application of knowledge, weaken the disadvantage of some students with weak academic performance, and create a more equitable learning environment. This has increased the self-confidence of some students and achieved higher self-efficacy. Meanwhile, it also declares that people's functional emotional arousal at a high level is the expectation and desire for success, and at the same time is the divergence of self-efficacy. Furthermore, before solving problems, people with high self-efficacy tend to think about problems from positive aspects and form positive expectations. When they encounter problems, they will also treat them with an optimistic attitude and less anxiety.

4.3. Learning Engagement

Learning perseverance is mainly reflected in tenacity, self-control, and self-confidence. It's metacognition of learning engagement. More study perseverance will lead to more self-confidence, and thus will be more committed to learning. In the process of STEAM learning, it is necessary to use the knowledge of a variety of disciplines to create, and a lot of time and energy are required. In the art major, when a project is obtained, it is necessary to propose a design plan, discuss in groups, brainstorm multidisciplinary materials, and reach a conclusion. Then, it is also necessary to debug, explore, modify, and so on. This requires students not only to have the ability to innovate, but also to have the ability and patience to learn, used to get satisfactory results. Just like Q2I1 states that "*The biggest thing I've learned from STEAM is that it has given me a lot of patience. The square funnel I designed in my Creative Design' class went through seven trials and finally worked. Before I tried it for the last time, I knew that if I changed one edge of it a little, it would be successful. I put a lot of effort to modify it, and finally got the desired result, I felt very confident. Then when I did the next project, I put in more, because I like this way, also like this kind of hard work myself.*" From his description, it can be seen that students' investment in getting satisfactory results can be proportional to their efforts. The more they want to get good results, the more energy they will put into it and the more confidence they will gain. What's more, students have behavioral and cognitive input into innovative learning. When they have clear and long-term learning goals, they will think positively, value and engage in learning to achieve good results. In the same way, Q2I5 claims that "*The ability to innovate in STEAM education is reflected in creation. It takes a lot of patience and commitment. Before creation, I need to think about the design plan, what to do and how to do it. After getting the plan, I also need to consider how to optimize it. Learning commitment is required in this process. I enjoyed the process, it gave me patience, and the final result gave me confidence to become more committed to learning.*" The key information from his narrative is that learning engagement in the ability to innovate is correlated with confidence and patience, and influences each other. At the same time, in innovative learning, students actively participate in learning tasks, enthusiastically participate in the inquiry process, and maintain confidence, which is a reflection of emotional investment in learning.

4.4. Creative Performance

Creative performances encourage students' creativity and reflect their innovative ability. It is an act of creative potential, the process of translating one's skills and energy into the use of ideas. Q3I3 states that *"Creativity is the most important learning ability for our students, especially for art and design students. Our ideas will evolve with creative performance, and we will come up with more and more novel ideas in the process of*

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expressing them. This is also the formation of creative thinking habits." It shows that creativity is important for art students, not just as a foundation for innovation, but as one of the programs of STEAM education. Arousing creative imagination, promoting creative practice and stimulating innovative thinking are the advantages of innovative learning ability. In such an atmosphere, students can experience the fun of doing, develop hands-on ability, develop the habit of creative thinking, and thus enhance innovation ability. Moreover, both Q3I1 and Q3I2 give the same idea of *"Active speech and mature speech in class make me more confident and have fun with innovative thinking. I love creative performances."* This shows that students gain confidence in creative performance to stimulate learning effectiveness. In innovation ability, the creative performance ability involves a wide range of design intuition, the ability to perceive beauty, imagination, expression and so on. The stimulation of these abilities helps to improve the overall ability of learning, so as to obtain more confidence in learning and stronger learning efficiency. Furthermore, 4 interviewees mention that "group communication" in this point, Q3I5, Q3I4 and Q3I2 have the similar idea with Q3I6, states that *"I really like the group planning in the STEAM class because I can be the researcher of the problem rather than the recipient. In group discussions, I was always quick to make judgments and creative performances, which won the recognition of the group members."* This might prove that students have more opportunities for creative performance in group communication, and they prefer to show their creativity in front of others and get satisfaction. This is the expected part of creative performance in group communication. Expressiveness is a way to influence others' perception of themselves and gain recognition. Students who are fully prepared to get good results when communicating, and thus get good recognition, will have a sense of fulfillment and excitement to enhance their ability and confidence in creative performance.

4.5. The Art College Students' Perspectives of Innovation Learning Ability under STEAM Education System at A University in China

STEAM education focuses on developing students' ability to translate knowledge into skills and be able to solve practical problems. It stimulates the subjective initiative of students, respects the subject status of students, takes teachers as the support of education, gives assistance to students, and helps students to understand and master knowledge and skills. For students, there is a need for more independence in the way of learning, which is more participatory than the traditional way of learning. This section analyzes two types of student perceptions, it responds to Q4 and Q5 respectively, and related to RO2.

4.6. The Perspective about STEAM Courses

In interviews with participants, when discussing their perceptions of innovative learning capabilities under the STEAM education system, most of them responded positively. Q4I6, Q4I1 and Q4I5 mentioned that the teacher's affirmation of them made them like STEAM courses. Q4I1 says that *"I always look forward to every STEAM education session. I love the look on the teacher's face when I come up with a new idea. I think it's an affirmation of my new idea."* They think STEAM teachers are giving them guidance rather than "teaching". It is different from traditional teaching methods. Same as Q4I6, who states that *"I like STEAM education because we can fully express our ideas in class, and the teacher will give us help when we need it, rather than the traditional way of listening to the teacher for a long time, and we will think about other things."* In STEAM classroom, teachers design and provide problem orientation, and students think and design

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creatively on the problems, form cognitive conflicts and stimulate the desire to explore, and carry out practice. The teacher is an observer, a listener, a mentor, a motivator, and a corrector, encouraging students to create their own value. Moreover, it is also believed that STEAM courses can allow them to experience the joy of thinking and creativity to a greater extent. Just like Q4I5 explains that *"I always have a lot of novel ideas for art and design courses, but I can't show them in traditional art classes. Only in STEAM class, I can show my creativity to my heart's content. I think for me, it makes me more involved in learning."* This shows that students prefer STEAM education, where they get more knowledge and fun. In STEAM classroom, students are not only learners, but also answer creators in response to questions. They work independently or in small groups to conduct practical inquiry, including designing schemes, hands-on operations, observing phenomena, establishing associations, identifying variables, and generalizing laws. The process is interesting and novel, giving students more creative thinking, interdisciplinary ability and learning confidence. Therefore, let the students learning by doing. However, not everyone is comfortable with this new type of classroom. One interviewee had a different idea of STEAM mode. Q4I2 stated that *"I think I am an introvert, and I am more accustomed to the comfort brought by traditional classes, so that I can learn knowledge quietly. You don't have to think too much, and you don't have to worry about group assignments. But I have to say that the STEAM class is fun and I enjoy it, it's just that I don't want to communicate too much with other students, but, who knows, maybe next school year I'll get used to it."* This may be a common thought among some people who are not good at communicating. In the STEAM class, students need to learn to solve problems on their own, rather than relying too much on the teacher. This also illustrates the impact of self-directed learning, learning engagement and learning confidence on STEAM courses.

4.7. The Perspective about Innovation Learning Ability under STEAM Education System

STEAM education advocates a diversified training model, and strengthens the cultivation of creative and innovative ability on the basis of problem solving. At the same time, the integration of multi-disciplinary resources allows students to have more opportunities for creative expression, enhance self-confidence, and become more committed to learning. In the interview on innovative learning ability in STEAM education, all interviewees believe that innovative learning ability is an important part of STEAM education and a necessary learning ability. Q5I4 states that *"I think creative learning ability is very necessary. The idea of learning and patience alone are not enough to support interdisciplinary courses. For example, when I was designing packaging bags, I used to use paper shells for design, but we found that when the pulp can have more room for variation, the course and design will become more interesting. Because it is a brand-new material, we are more willing to try it, which can better reflect our learning value."* The message from these statements is that students generally have a high sensitivity to new things and are willing to experience new ways. In other words, the ability to innovate is the product of attention to detail, multi-perspective observation and a sense of real experience. It changes the way of thinking through cross-border thinking, reverse thinking and creative tools, and improves effective learning methods through pluralistic learning and practical exploration. Furthermore, Q5I3 believes that innovative learning ability is the inevitable product of modern society, and with the progress of society and the renewal of human wisdom, innovative ability is the embodiment of the word "new" and states that: *"of course, the ability to innovate itself is a learning ability that students in modern society should have. It follows the development of society. The society is progressing, and the problems arising in the society are also being updated. If we just stay in the past solutions,*

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we will not be able to follow the new era. That's what makes STEAM education new, innovative." It can be seen that innovative learning ability is a necessary skill, is a new attribute, it involves change and creation. For individuals, improving their own innovative learning ability can not only achieve better achievements in learning, but also enhance observation, thinking mode and creativity. In addition, some interviewees have further ideas, believing that not only innovative learning ability needs to be possessed, but also needs to be trained to have more creative ideas. It can be seen that Q5I5 claims that *"I think innovative learning skills are necessary in the STEAM classroom. I am also willing to follow the guidance of teachers and strengthen training in this ability. Sometimes, our ideas are not a lot, we need teachers in peacetime to help us more divergent thinking."* Similarly, Q5I2 states that *"I hope the teacher can give us more creative thinking practice activities, so my brain will not just stay in the original idea."* This shows that creativity not only comes from personal thinking, but also depends on acquired training, and students are eager to get more training from teachers to get better innovative learning ability.

5. Conclusion

The article findings elucidated that self-efficacy, learning engagement, and creative performance are the three factors influence innovation learning ability under STEAM education system. Meanwhile, students' perspectives about innovation learning ability under STEAM education system are positive and energetic. This article explores the influencing factors of innovation ability, which is a great help to students' self-development and improvement of learning ability. Based on this study, students can have a clearer understanding of their learning ability and artistic innovation ability. They can face the challenges when encountering learning difficulties. At the same time, teachers can better understand students' perspectives on innovative learning ability in STEAM education, and better understand students' ideas and needs, so they can guide students to high-quality learning better. More importantly, for the society, the exploration of students' innovative ability can reflect the concern and expectation of the society for students, and give certain support. This research can be used as a theoretical basis in the field of STEAM art education and a reference for future STEAM curriculum practice, encouraging students to try new ideas and methods, so as to complete greater innovative tasks and welcome the arrival of a new era of innovation.

Ethics Approval and Consent to Participate

The researchers used the research ethics provided by the the Senate of Infrastructure University Kuala Lumpur (IUKL). All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional research committee. Informed consent was obtained from all participants prior to study commencement.

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Conflict of Interest

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

References

Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of personality and social psychology, 45*(2), 357.

Astin, A. W. (1986). Excerpts from Achieving educational excellence. *Equity & Excellence*, *22*(4-6), 12-31.

Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive therapy and research, 1*(4), 287-310.

Bekele, W. B. & Ago, F. Y. (2022). Sample Size for Interview in Qualitative Research in Social Sciences: A Guide to Novice Researchers. *Research in Educational Policy and Management, 4*(1), 42-50.

de Vries, H. (2021). Space for STEAM: New creativity challenge in education. *Frontiers in psychology, 12*, 586318.

Dong, A., Jong, M. S. Y., & King, R. B. (2020). How does prior knowledge influence learning engagement? The mediating roles of cognitive load and help-seeking. *Frontiers in psychology, 11,* 591203.

Doo, M. Y., & Bonk, C. J. (2020). The effects of self-efficacy, self-regulation and social presence on learning engagement in a large university class using flipped Learning. *Journal of Computer Assisted Learning, 36*(6), 997-1010.

El-Sayad, G., Md Saad, N. H., & Thurasamy, R. (2021). How higher education students in Egypt perceived online learning engagement and satisfaction during the COVID-19 pandemic. *Journal of Computers in Education, 8*(4), 527-550.

Farmer, H., Xu, H., & Dupre, M. E. (2022). Self-efficacy. In *Encyclopedia of Gerontology and Population Aging* (pp. 4410-4413). Cham: Springer International Publishing.

Gkintoni, E., & Dimakos, I. (2022). An overview of cognitive neuroscience in education. *EDULEARN22 Proceedings,* 5698-5707.

Guilford, J. P. (1967). Creativity and learning. *Brain function, 4,* 307-326.

Guest, G., Bunce, A., & Johnson, J. (2006). How Many Interviews Are Enough? An Experiment with Data Saturation and Variability. *SAGE Journals*, 59-82.

Halverson, L. R., & Graham, C. R. (2019). Learner engagement in blended learning environments: A conceptual framework. *Online Learning, 23*(2), 145-178.

He, L. D., Li, K. D., Zheng, Y., Li, H., Yan, C., Han, Y., & Zang, Y. J. (2019). Research on a creativity-oriented STEM teaching model. *Open Educ. Res, 25*, 66-74.

Huo, L., Zhan, Z., Mai, Z., Yao, X., & Zheng, Y. (2020). A case study on C-STEAM education: Investigating the effects of students' STEAM literacy and cultural inheritance literacy. In *Technology in Education. Innovations for Online Teaching and Learning: 5th International Conference, ICTE 2020, Macau, China, August 19-22, 2020, Revised Selected Papers 5* (pp. 3-12). Springer Singapore.

Jia, Y., Zhou, B., & Zheng, X. (2021). A curriculum integrating STEAM and maker education promotes pupils' learning motivation, self-efficacy, and interdisciplinary knowledge acquisition. *Frontiers in psychology, 12,* 725525.

Kariippanon, K. E., Cliff, D. P., Lancaster, S. J., Okely, A. D., & Parrish, A. M. (2019). Flexible learning spaces facilitate interaction, collaboration and behavioural engagement in secondary school. *PloS one, 14*(10), e0223607.

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Li, S., Wang, S., Du, J., Pei, Y., & Shen, X. (2022). MOOC learners' time-investment patterns and temporal-learning characteristics. *Journal of Computer Assisted Learning, 38*(1), 152-166.

Liu, H., Shao, M., Liu, X., & Zhao, L. (2021). Exploring the influential factors on readers' continuance intentions of E-Book APPs: personalization, usefulness, playfulness, and satisfaction. *Frontiers in Psychology, 12*, 640110.

Meng, S. M. (2023). Research on cultivating students' innovative ability under STEAM education concept. *Jiaoyujie*, 31, 62-64.

Nong, L., Liao, C., Ye, J. H., Wei, C., Zhao, C., & Nong, W. (2022). The STEAM learning performance and sustainable inquiry behavior of college students in China. *Frontiers in psychology, 13,* 975515.

Petillion, R. J., & McNeil, W. S. (2020). Student experiences of emergency remote teaching: Impacts of instructor practice on student learning, engagement, and well-being. *Journal of Chemical Education, 97*(9), 2486-2493.

Schunk, D. H., & DiBenedetto, M. K. (2021). Self-efficacy and human motivation. In *Advances in motivation science* (Vol. 8, pp. 153-179). Elsevier.

Sha, J., Shu, H., & Kan, Z. (2021). Analysis of critical thinking path of college students under STEAM course. *Frontiers in Psychology, 12*, 723185.

Sanz-Camarero, R., Ortiz-Revilla, J., & Greca, I. M. (2023). The Impact of Integrated STEAM Education on Arts Education: A Systematic Review. *Education Sciences*, *13*(11), 1139.

Shen, S., Wang, S., Qi, Y., Wang, Y., & Yan, X. (2021). Teacher suggestion feedback facilitates creativity of students in STEAM education. *Frontiers in Psychology, 12*, 723171.

Smiderle, R., Rigo, S. J., Marques, L. B., Peçanha de Miranda Coelho, J. A., & Jaques, P. A. (2020). The impact of gamification on students' learning, engagement and behavior based on their personality traits. *Smart Learning Environments, 7*(1), 1-11.

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management journal, 45*(6), 1137-1148.

Wang, Y. Y., Weng, T. H., Tsai, I. F., Kao, J. Y., & Chang, Y. S. (2023). Effects of virtual reality on creativity performance and perceived immersion: A study of brain waves. *British Journal of Educational Technology, 54*(2), 581-602.

Wang, L. X. & Wang, H. Y. (2023). The cultivation of young people's innovative ability from the perspective of STEAM education. *Academy*, 35 (47-49).

Wei, Z., Li, H., Zhong, C. Z. (2023). The current situation, significance and feasibility of STEAM course construction for general normal college students in higher vocational colleges based on interdisciplinary literacy. *Quality Education in Western China*, 9(24), 31-34.

Wu, H., Li, S., Zheng, J., & Guo, J. (2020). Medical students' motivation and academic performance: the mediating roles of self-efficacy and learning engagement. *Medical education online, 25*(1), 1742964.

Yue, S., Li, X. & Zhao, M. (2021). Research on the Cultivation of Innovative Ability of College Students Based on STEAM Education Concept. *Science and Technology Management*, 22-23.

Zheng, J., Xing, W., Zhu, G., Chen, G., Zhao, H., & Xie, C. (2020). Profiling self-regulation behaviors in STEM learning of engineering design. *Computers & Education, 143,* 103669.

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