Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 7220957, 10 pages
https://doi.org/10.1155/2022/7220957

Research Article

PLS-SEM Model of Integrated Stem Education Concept and Network Teaching Model of Architectural Engineering Course

Ping Wang

Department of Architectural Engineering, Handan Polytechnic College, Handan 056001, China

Correspondence should be addressed to Ping Wang; wangping0074@163.com

Received 15 March 2022; Revised 4 April 2022; Accepted 15 April 2022; Published 2 May 2022

Academic Editor: Wei Liu

In order to cultivate talents more effectively in construction engineering and cultivate students' critical thinking, creative thinking, high-level thinking, as well as students' perseverance, learning ability, global competence, and responsibility, combined with the integrated stem education concept, this paper makes an in-depth study on the online teaching model of construction engineering course in PLS-SEM mode. This paper mainly discusses how to apply stem education concept in architectural engineering teaching through literature analysis and the design of architectural engineering teaching cases. Take the integrated stem education concept as the guiding ideology, design research as the methodological guidance, and learn from the research model of design research in the field of curriculum and teaching "formative research." After the prototype of the teaching mode is put forward, with three rounds of iterative implementation and revision, a feasible and effective mathematics teaching mode in Engineering Higher Vocational Colleges under the concept of stem education (hereinafter referred to as "stem-HVE teaching mode") is finally obtained. It provides a new way for engineering teaching and opens a new chapter of integrated stem education in the field of engineering teaching.

1. Introduction

Stem is the abbreviation of science, technology, engineering, and mathematics, as shown in Figure 1. The integrated stem education concept aims to place the core content of stem field in a real and attractive problem situation, adopt a problem-solving driven student-centered teaching method, support students' learning of mathematics and/or science content, and help students acquire engineering design and/or technical means. At the same time, by emphasizing the integration between middle schools and disciplines in the process of displaying problem-solving, it helps students understand the close relationship between disciplines, experience the value of disciplines, and cultivate new skills in the 21st century, positive attitude towards stem disciplines, and enthusiasm for stem career [1]. Integrated stem education can help engineering higher vocational education achieve the goal of talent training. When applied to the discipline of construction engineering, the integrated stem education concept not only supports students' learning of construction engineering, but also improves students' learning attitude and promotes their understanding of construction engineering, to make education truly serve the engineering specialty. Under the new normal of China's economy, the driving force of growth is changing from factor driven and investment driven to innovation driven. This transformation is in line with the development of economic, natural, and social laws and also reflects the country's urgent demand for high-level human resources. To develop an innovative country and improve the level of human capital, education reform is the "first chess." Only first-class education can have first-class talents and build a first-class country [2]. As a new direction of education reform in the 21st century, stem education has attracted extensive attention all over the world and is recognized as an effective way to enhance innovation and competitiveness.

Table 1: Level of discipline integration.

Integration level	Characteristic
Discipline integration	Acquire skills and concepts by learning a subject alone
Multidisciplinary integration	Learn from one project and master the concepts and skills of different disciplines
Interdisciplinary integration	Deepen the skills and concepts of each discipline through the study of two or more disciplines
Interdisciplinary integration	Through the study of two or more disciplines, acquire interrelated concepts and skills, match with practical activities, and strengthen the application of skills

2. Literature Review

Plessis A. and others believe that, with the continuous advancement of stem education, many educators in the world have recognized its teaching methods. Stem education should run through the whole learning stage of learners, carry out all-round training through formal in-school learning, and then polish it through informal out-of-school learning, so that mathematics, science, technology, and engineering are gradually integrated [3]. Plutynski A. and others said that, in the process of discipline integration, enterprises and business circles pay more attention to the practical ability of workers, while many theoretical knowledge and practical work are in contradiction. Therefore, in the view of integration, some scholars also issued a questionnaire, as shown in Table 1 [4].

Dewsbury and others believe that, in the integrated learning of stem education, more attention is paid to the connection between disciplines and knowledge. Through dynamic learning methods, learners can better master the application skills of acquiring abilities and skills in practice, apply the learned knowledge, alleviate the contradiction between theoretical knowledge and practical work in society, and further improve the application value of learning in society [2]. Jones and others said that, in the new era, structural equation model, namely, PLS-SEM, is an analysis method widely used in the field of statistics in recent years. It can flexibly deal with various complex variables and is widely used in statistics, economics, management, sociology, and other fields [5]. Woodford and others believe that, in order to widely apply it to the network education of current architecture courses, it should be modified to deal with the design of each section of architecture network courses flexibly [6]. Dolighan and Owen believe that, with the continuous promotion and application of SEM, the commonly used SEM software at present includes Amos, smartplis, LISREL, and so on. Most of LISREL and Amos use the maximum likelihood method to estimate the variables through estimation, which has high requirements. If the number to be counted is no more than 200, it is difficult to obtain a more stable solution. However, it is difficult to collect more than 200 kinds of variables in relevant fields, especially in the field of education. Therefore, it is difficult to ensure its stability by using the maximum likelihood method [7]. Verma A. and others believe that the model can be set through PLS-SEM through the least square method, which is different from other algorithms. This PLS-SEM model is easier to establish in the network teaching of architectural engineering courses [8]. Rodic and Rodic said that the online teaching of architectural engineering courses should have the education and learning contents of organization, tracking, evaluation, sending, and management, promote the interaction between learners and the network, and master various concepts and skills in the field of architecture in the process of continuous interaction. In the process of model design, it can be designed mainly through learning resource database, management system, content system, and general network [9]. Zhao et al. and others said that, in the process of practice, previous designs also exposed many problems, which hindered the effective development of construction engineering online education curriculum, lacked the cognition of practical teaching, and generally existed the educational concept of emphasizing theory and neglecting practice [10]. However, Hermans et al. and others said that, in the current era, all sectors of society pay more attention to learners' practical ability in the process of employment. Many learners' basic cultural level is relatively weak, and it is difficult to achieve effective practical effect if the teaching method is mainly lecture [11].

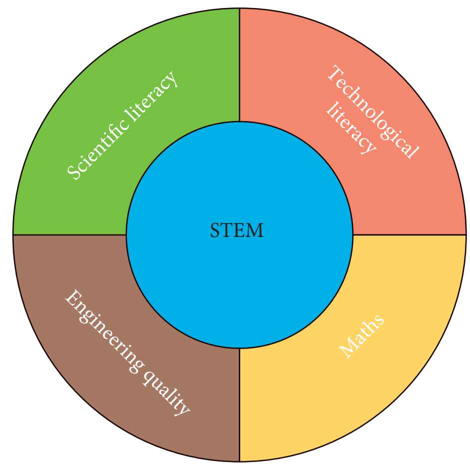

Figure 1: Stem concept diagram.

3. Method

3.1. Solutions to Research Problems

3.1.1. Principles of Stem Education. In stem education, education and teaching need to be closely connected with each other, cultivate learners' further skills through integration, and teach learners the ability to solve practical problems through theoretical knowledge.

First, we should follow its interdisciplinary principle in education. From the perspective of stem, we should subdivide various disciplines, including the main educational disciplines, make reasonable planning, deeply study the interrelated places between various disciplines, strengthen the links between disciplines, and strengthen learners' learning effect and absorption ability. Stem represents the fields of science, technology, engineering, and mathematics, which are closely related to each other. In stem education, we should not only focus on a single discipline, but also emphasize the communication and connection between disciplines, to cross the boundaries between disciplines and cultivate learners' ability of comprehensive thinking, so that learners can think from multiple angles to solve problems [12], as shown in Figure 2.

Second, the principle of interest should be followed. Stem's new educational concept is an educational policy born in the new era, and in the new era, all sectors of society also put forward different requirements for the education industry. Many scholars believe that education in the new era should break the traditional constraints, strengthen learners' learning motivation and enthusiasm through flexible and interesting education methods, stimulate learners' sense of achievement, and let learners experience happiness in the learning process. Therefore, in the process of education, teachers should pay attention to integrating the concepts of various disciplines into different situations to stimulate learners' skills and enable learners to have more initiative in the learning process [13].

Third, we should follow the principle of experience. In the process of education, stem education should actively cultivate learners' practical ability and enable learners to participate in the learning process by means of hands-on and brain use. Learners should also skillfully use their theoretical knowledge to solve various problems, so that learners can skillfully use more skills in the process of practice, experience more learning and practice methods, and strengthen learners' adaptability to various fields of society.

Fourth, the principle of cooperation should be followed. In stem education, in order to strengthen the learning effect in an all-round way, when designing teaching, teachers should emphasize the cultivation of the cooperative ability of learners, let learners help and inspire each other in the learning process, and build a learning community in a new era. At the same time, we can also strengthen the communication between teachers and experts through community, so that learners can actively participate in communication and discussion, and combine learning with the environment. In this way, learners can also collect learning materials in the community, ask more questions, and discuss with each other how to better complete learning tasks and strengthen learners' cooperation, which will be of great help to their work and life in the future [14].

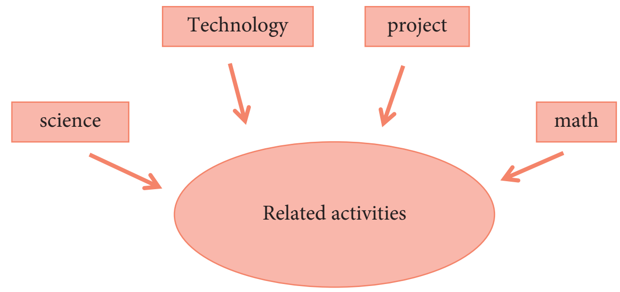

Figure 2: Curriculum integration of stem education.

3.1.2. PLS-SEM Mode Architectural Engineering Course Design Scheme from the Perspective of Stem. In PLS-SEM mode, the course design of architectural engineering should follow the structural equation model, which is divided into measurement model and structural model. Since the measurement model represents the correlation between observation variables and latent variables, the measured model can also become an external model, while the structural model can also become an internal structure due to the correlation between internal variables [15]. During the establishment of external model, the relationship between each variable and potential variable should be observed, as shown in formulas (1) and (2):

$$x = A_x' \xi + \eta_x, \tag{1}$$

$$y = A_y' \eta + \eta_y. \tag{2}$$

The vector composed of exogenous indicators is set as x, the vector composed of endogenous indicators is set as y, the exogenous latent variable is set as ξ, while the endogenous latent variable is set as η, A_x' is the factor load of exogenous indicators on exogenous latent variables, and A_y' is also the factor load of endogenous indicators on endogenous latent variables. The relationship between exogenous indicators and exogenous variables can also be shown through the formula. At the same time, the relationship between endogenous indicators and endogenous variables can also be investigated. The nonerror between them can be expressed by η_x and η_x. Therefore, the weight relationship equation between them can also be obtained, as shown in equations (3) and (4):

$$\xi_1 = \sum_h w_{th} x_{th}. \tag{3}$$

$$\eta = \sum_k w_{th} y_{th}. \tag{4}$$

w_{th} is the h-th weight of the estimated latent variable ξ_1 and x_{th} is the h-th observation value of the estimated latent variable ξ_1. At the same time, the estimated variables can also be shown by the right equation, and the weight coefficients and weight observations between each other can also be expressed by $\sum_k w_{th}$, etc. The method adopted in this paper is based on in-depth study of architectural engineering design, combined with stem education concept and PLS-SEM, designed the online education course of architectural engineering through various design modes, and finally designed several education stages for the overall online learning course [16].

First, the participation stage: The design should adhere to the basic goal of stimulating learners' enthusiasm and paying attention to improving learners' participation. Teachers should give a certain degree of advance notice of the course content in the process of teaching, so that learners can preview before class, to produce the initial concept and understanding of the classroom teaching content and guide the learners through questions to explain their self-understanding of the course, to evaluate the learners' understanding ability and design level. Learners should also strengthen their mastery of learning objectives and be familiar with the learning contents to a certain extent through review.

Second, the exploration stage: In the design of this stage, we should also pay attention to providing more opportunities for learners to build themselves, so that learners can build their own value system and understanding ability through the exploration stage, strengthen the training of practical ability, and let learners ask questions according to the problems generated in the process of practice and exploration. Teachers should also guide learners, so that learners have the desire to actively explore and ask questions, and provide learners with learning materials to guide learners to think further [17]. Teachers should establish the concept of modeling in teaching, put forward the guidance of various problems to learners, judge learners in the process of exploration, and then promote learners' understanding of learning content and participate in class learning together through group data collection and brainstorming.

Third, the interpretation stage should be carried out. In the interpretation stage, learners should be given the ability to reflect. Teachers should also deeply modify and refine various knowledge in this stage. Learners should also actively use various concepts and do a good job in the production process of design scheme. Teachers take this opportunity to explain the principles of various theoretical knowledge to learners and let them master it. Among them, they should also pay attention to communication and exchange, let learners restate the summarized knowledge, let learners have in-depth communication and cooperation, promote the connection with each other, and let learners establish correct concepts through guidance [18].

Fourth, the engineering stage should also be combined with the design of PLS-SEM. It should focus on enabling learners to apply the knowledge they have learned in practical engineering examples and enable learners to grasp the practical application of various concepts and skills more deeply, focusing on cultivating learners' practical ability. For example, the devices in the construction are used in the aspects of test and verification, construction principle, construction technology, etc., and the teaching concepts designed by teachers are restated to enable learners to learn in exploration, monitor and manage learners' production process, and improve various design schemes [19].

Fifth, in the deepening stage, learners should strengthen their ability to apply various knowledge and skills and deepen learners' application of various complex engineering concepts. At the same time, we should also strengthen learners' knowledge understanding in the learning process. Teachers can provide learners with new material resources and let learners use what they have learned before and integrate into the new field of knowledge. It can not only strengthen the integration ability, but also give play to the characteristics of rich resources in online education, guide learners to further communicate and discuss, and then combine it with new situations to try and explore, so that learners can master more new technologies, new devices, and new methods. In the final evaluation stage, teachers need to test the learning effect of learners and promote teachers' mastery of learners' ability through the test work, to flexibly master targeted educational methods in the teaching process of the next stage, and strengthen the interaction between teachers and learners [20]. Through the feedback platform, learners can also feedback teachers' opinions in the learning process or communicate with teachers' deficiencies in the teaching process, so as to reduce the adverse phenomena that it was difficult for both sides to communicate effectively in the past and strengthen the effectiveness of construction engineering network education courses.

3.2. Integrated Stem Education Concept and Teaching Process. Under the concept of integrated stem education, teachers play the role of organizer, guide, and helper in the biology teaching process of junior middle school. The flowchart is shown in Figure 3 [21]. Teachers' work contents include the following:

(1) Create engineering or scientific situations close to students' personal experience
(2) Explain the core concepts of biology and interdisciplinary concepts
(3) Through situational analysis, questioning and inspiration, demonstration experiment, sharing information, providing examples, and other teaching supports, we can help students explore and practice and help students solve problems or complete projects and observe students' performance and give performance evaluation
(4) Listen to group communication and arrange intensive exercises according to the results of different groups
(5) After solving the problem or completing the project, give a summary evaluation according to the results and performance of the group

As the explorer, builder, and finisher of stem project, students mainly work as follows:

(1) Clarify the theme of interdisciplinary projects according to the engineering or scientific situation created by teachers.
(2) Construct the core concepts of biology and interdisciplinary concepts in combination with teachers' lectures and materials consulted before class.
(3) After the division of labor is clear, the group will carry out orderly coordination and cooperation.

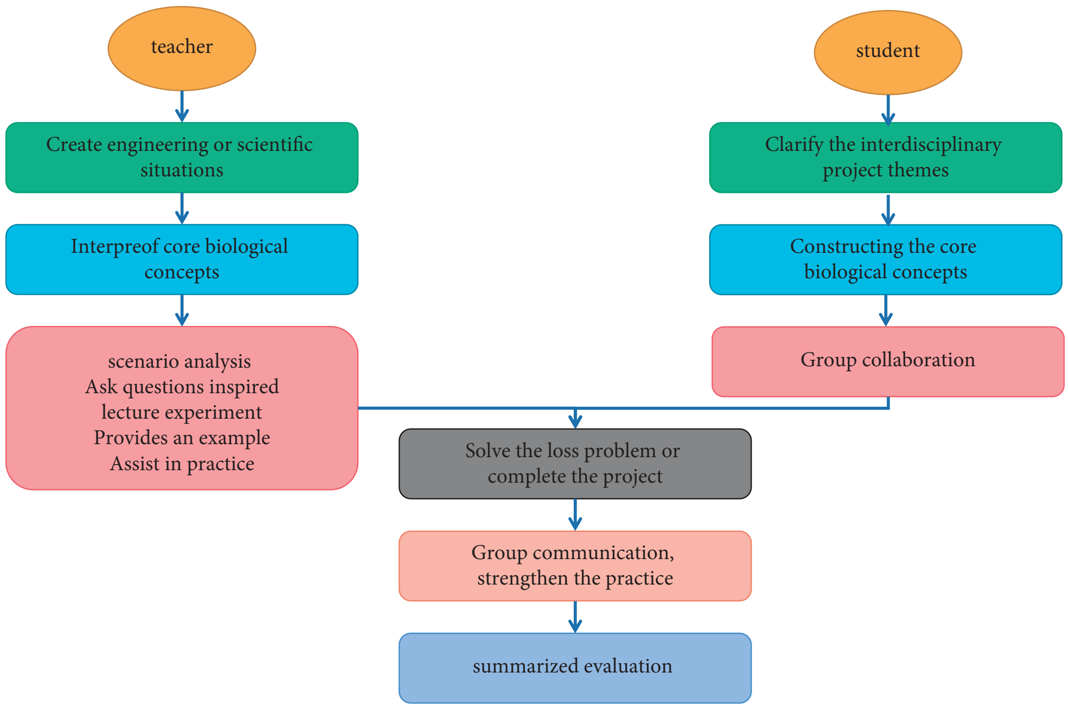

Figure 3: Teaching flowchart of integrated stem education concept.

(4) Jointly complete the practical exploration driven by the project or problem, including expressing the problem, summarizing the specific requirements, evaluating the scheme, and communicating the problem. This is a multiround and dynamic revision and improvement process. And finally solve the problem or complete the project.

The group will conduct intragroup and intergroup communication on the results obtained and complete the intensive exercises arranged by the teacher.

The teaching process includes five links: creating engineering or scientific situations and clarifying the theme; clarifying the core concepts of biology; team work to revise and improve repeatedly, solve problems, or complete projects; reporting results; intensive exercise. The key to the implementation of teaching process lies in the creation of engineering and scientific situations. Different ways of putting forward teaching topics will lead to different students' enthusiasm and participation. Before integrated stem teaching, teachers must complete more detailed and sufficient preclass preparation than conventional teaching in order to ensure the smooth progress of teaching [22]. According to the stem interdisciplinary project design pattern, extract the preclass preparation that teachers need to complete, as shown in Figure 4.

Teaching analysis is mainly a detailed analysis of teaching objectives, interdisciplinary learning content in teaching, and learner characteristics from the perspective of integrated stem education concept [5]. The learning task design of integrated stem teaching with "project or problem" as the core mainly includes the design of tools and resources, learning support, activity process, and evaluation scale.

3.3. General Steps of Engineering Design Process. Using engineering practice or design as the realistic situation of integrated stem education, it is necessary for us to understand the steps that engineers generally experience when doing engineering design or practice, that is, the core of engineering practice: engineering design process [23]. The engineering design process is generally carried out in seven stages, as shown in Figure 5.

Stage 1: identify problems and constraints. When engineers face engineering tasks or projects, they first need to identify problems for three purposes: first, determine work objectives; second, analyze the views of stakeholders of the project and find ways to integrate them into the design; third, clarify all restrictions (such as objective or subjective constraints such as time and supply) and standards (the characteristics to be met by the final product, such as beauty and energy conservation) [24]. This step is very important. At this stage, each participant needs to reach a consensus on the design objectives and limits.

Stage 2: basic research. Facing a certain engineering task or project, the engineer will first do some background and basic research, to get the necessary information for drafting the preliminary design scheme. For example, understand the background knowledge and supplement the domain knowledge; investigate the previous work related to the design theme to avoid repeated work; be familiar with design evaluation standards; and even be familiar with rules, customs, laws, environmental problems caused by investigation, and design [25].

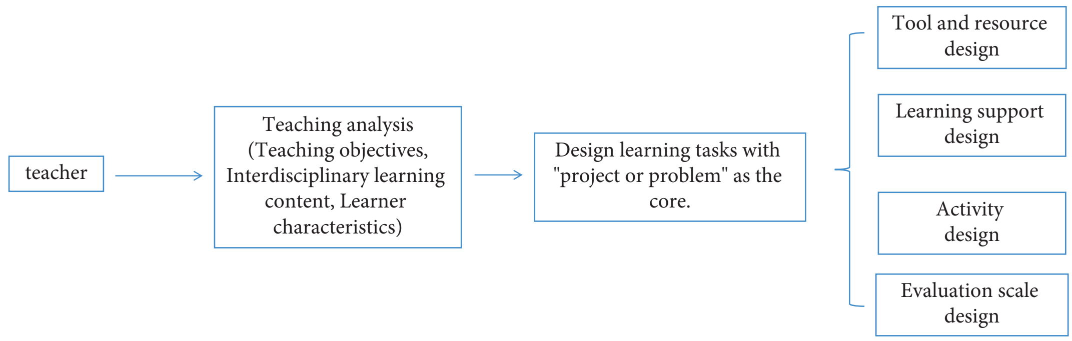

Figure 4: Preparation for integrated stem teaching.

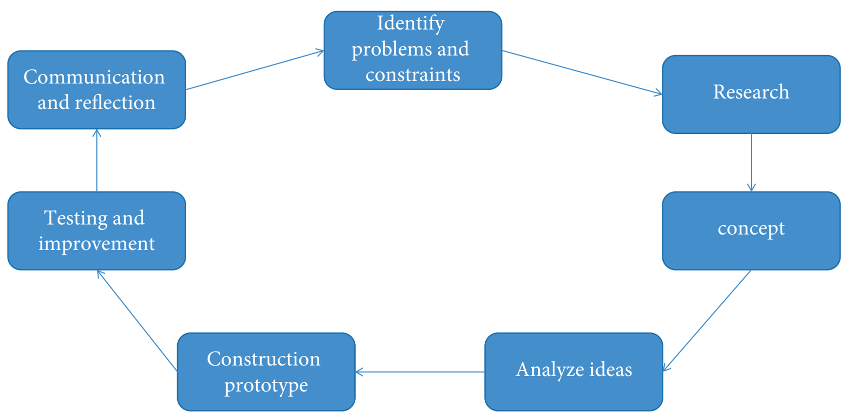

Figure 5: Engineering design process 7 stages.

Stage 3: conceive. Engineers usually need to conceive several different solutions first and then further analyze them to get the optimal solution. "Creation" is the focus of this stage. In order to stimulate inspiration, engineers usually use "brainstorming." This method is very effective in solving a specific problem and can produce a series of new high-quality ideas.

Stage 4: analyze ideas. At this stage, engineers will use mathematical and scientific knowledge and principles to refine and improve the scheme initially constructed in the previous stage and select the best feasible scheme according to customer needs and situational constraints. For example, establish mathematical models to predict the performance of different schemes. In this process, engineers will make extensive use of mathematics, comprehensively consider the conflict between standards and constraints, and critically evaluate and exchange the advantages and disadvantages of each design scheme. If there are problems in the analysis, the engineer needs to reflect and return to a previous stage.

Stage 5: build the prototype. After establishing the best design scheme, the engineer needs to construct a full-scale working model or sample. It should be noted that the products of the project are not always materialized. The goal of a project can be a new design process, scheme, etc.

Stage 6: test and refine. Engineers use technical means to empirically test and evaluate the prototype and establish a comprehensive evaluation file, including test conditions, observation results, etc. If there are problems in the test, the engineer needs to reflect and return to the previous stages.

Stage 7: communicate and reflect. The era of engineers working alone in a small attic has ended. Modern engineering design needs effective communication. There are at least four forms of communication: face-to-face, oral, visual, and written communication.

The above seven stages are a cyclic and iterative process, and iteration is an important feature of the engineering design process. Through this process, engineers gradually develop engineering thinking and the ability to analyze and solve problems by using mathematical tools and scientific knowledge.

4. Conclusion and Analysis

4.1. Experimental Method to Verify the Scheme. In course design, PLS-SEM is generally used to discuss the analysis method of the relationship between latent variable and manifest variable. In structural equation model, the relationship between variables is the most important to be analyzed. In curriculum design, learners' satisfaction with class, course time, teachers' teaching quality, and the rationality of curriculum design can be regarded as different variables and latent variables. According to the characteristics of these variables, in the process of classification and integration, we should also clearly know the abstraction of the variables themselves. Many variables that are difficult to measure directly can only be estimated. However, the advantage of PLS-SEM is that it can carry out regression analysis between many variables where it is difficult to obtain accurate values and multiple dependent variables. When setting the regression path, it is calculated by analyzing each dependent variable separately. Although the measurement error is difficult to avoid, it can be assumed that there is no error in the independent variables, and the variables of the structural equation in the analysis process contain measurement error [26].

The least square path based on PLS-SEM can be constructed through new multivariate analysis technology, regression path, and modeling. The structural equation model also has two kinds of variables. We strive to build the model by taking the minimum variable value and then stabilize it through iterative parameters such as formulas (5) and (6):

$$\eta = \pi_{\eta} y + \partial_{\eta}. \tag{5}$$

$$\xi = \pi_{\xi} x + \partial_{\xi}. \tag{6}$$

η and ξ are endogenous variable vectors, x and y decibels represent the explicit variable vectors of endogenous and exogenous variables, π_{η} and π_{ξ} are coefficient matrices, and ∂_{η} and ∂_{ξ} are residual vectors. The reaction model is constructed, as shown in Figure 6. It also includes various variables such as x_{11}.

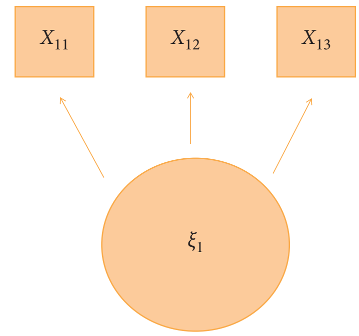

Figure 6: Schematic diagram of reaction model.

In the network curriculum design of construction engineering, stem education should represent the way of curriculum organization, reduce the impact caused by the neglect of the relevance between various disciplines and subjects in traditional education, and let learners make adaptive groundwork for future work planning and career development, to help learners have a deeper understanding of the discipline. For example, in architecture curriculum, it can relate to psychological curriculum and artistic aesthetic curriculum. Through detailed curriculum arrangement and careful coordination plan, it can carry out common learning among various disciplines, which also requires teachers of various disciplines to negotiate and communicate together, to strive for the rationality and effectiveness of curriculum design and strengthen the learning effect of learners. In the process of integration, when integrating knowledge, teachers should focus on more complex or valuable problem situations and let learners understand and construct the knowledge system in the way of cooperation, to form the ability to use their own knowledge and skills to solve various problems in the current practical life and strengthen the application ability of knowledge, make full use of the relevance between the situation and the problem, and give full play to the effectiveness of the situation and learning. In addition, in the process of learning, we should also pay attention to the integration with life, which is also to build the main framework of learning for learners through lifestyle and further deepen that learner can solve various problems in life through knowledge. Through academic knowledge, the problems in life can be transformed, so that learners can experience the practical application of knowledge from life or work and strengthen their enthusiasm for learning.

4.2. Analysis of Students' Learning Experience. After the implementation of teaching activities, in order to understand the students' learning experience in this teaching activity, a questionnaire is adopted for investigation. A total of 10 questions were compiled around the three dimensions of learning interest, teaching design, and teaching implementation, including 3 learning interests, 3 teaching designs, and 4 teaching implementations. A total of 85 test papers were distributed, 85 were recovered, and 85 valid questionnaires were received, with a recovery rate of 100%.

4.2.1. Reliability Analysis of Questionnaire. Cronbach's alpha is used to analyze the reliability of the three dimensions of teaching effect questionnaire, learning interest, teaching design, and teaching implementation. The reliability of each dimension is shown in Table 2.

According to the research, the reliability coefficients of the questionnaire are 0.782, 0.757, and 0.746, respectively, and the coefficients are between 0.7 and 0.8, indicating that the questionnaire has high reliability and can be studied.

4.2.2. Questionnaire Validity Analysis. This paper analyzes the questionnaire from three dimensions: learning interest, teaching design, and teaching implementation. Questions 1–3 are the investigation of learning interest, including practical ability, cooperation and exploration ability, and technical and cultural understanding.

As shown in Figure 7, the analysis and survey results show that, in the process of this teaching activity, more than 87% of students have high interest in learning this teaching activity and think that their practical ability can be greatly improved, and less than 13% of students are uncertain. However, more than 87% of the students said they were very satisfied with the teaching activity and 13% of the students maintained an uncertain attitude. Therefore, according to the overall teaching effect, the satisfaction is very high.

As shown in Figure 8, the survey results show that more than 88% of the students agree with this teaching activity and think that they have completed the teaching task perfectly in the activity, and their cooperation ability and independent inquiry ability have been improved to a certain extent. Only

Table 2: Reliability test of each dimension.

Reliability index	Reliability coefficient	Number of problems
Learning interest	0.782	3
Instructional design	0.757	3
Teaching implementation	0.746	4

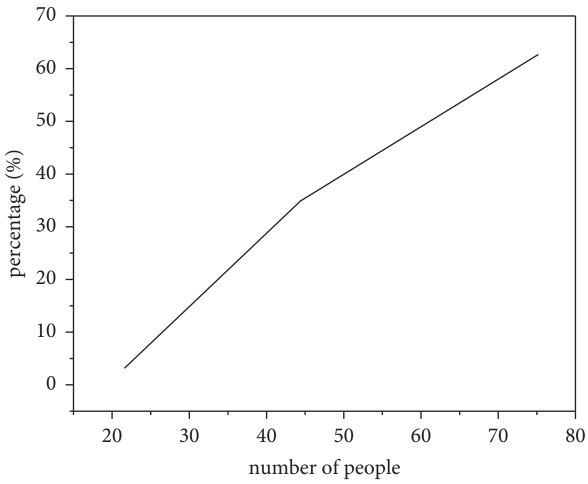

Figure 7: Survey of practical ability.

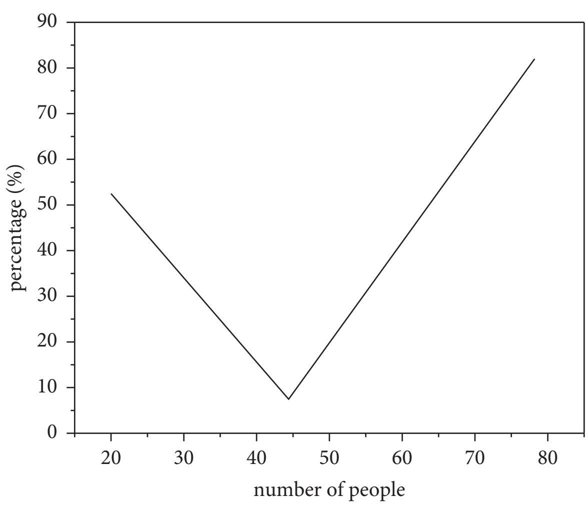

Figure 8: Survey of cooperation and inquiry ability.

12% of the students are uncertain about whether to acquire the ability. However, more than 88% of the students agree with the ability acquired in their activities, and 12% of the students maintain an uncertain attitude. Therefore, according to the overall teaching effect, the degree of recognition is very high.

As shown in Figure 9, the survey found that more than 90% of the students said that the teaching theme and activities made them full of interest in general technology courses, and less than 10% said that their interest in learning was average. The content of this teaching activity involves students' understanding of folk traditional crafts. In the

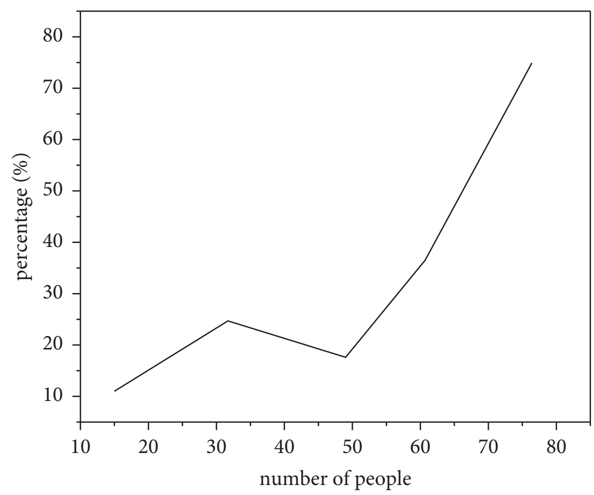

Figure 9: Technical culture understanding survey.

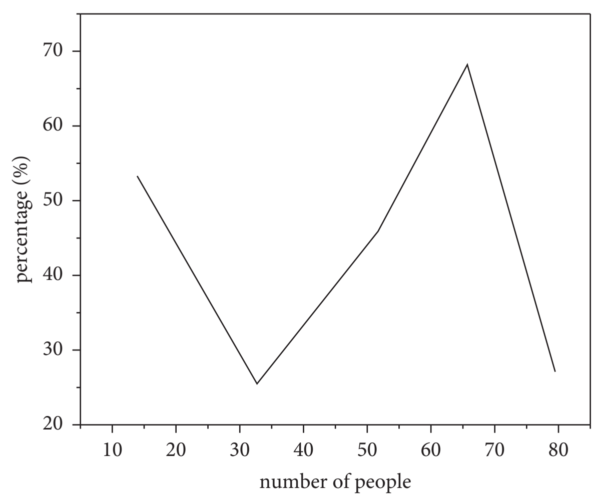

Figure 10: Survey of teaching topics.

form of interview, students' spare time is selected for investigation. It is found that they show great interest in traditional culture, which virtually gives good encouragement and recognition to the teaching and research at this stage. It shows that this teaching activity has a good effect on students' in-depth understanding of technical culture and deepening their love of traditional culture.

Questions 4–6 mainly investigate the students' recognition of this traditional folk culture teaching activity. According to the statistical results, it is found that the teaching theme content and learning objectives meet the students' learning needs for general technology courses to a certain extent, and the students have a high degree of recognition, as shown in Figure 10, indicating that the teaching is relatively successful.

Questions 7–10 are a survey of the teaching implementation stage, including teachers' explanation of cases, division of labor within the group, improvement of learning skills, and evaluation of self-learning and group cooperative learning. The students' satisfaction with the teacher's case explanation is shown in Figure 11. The survey results show

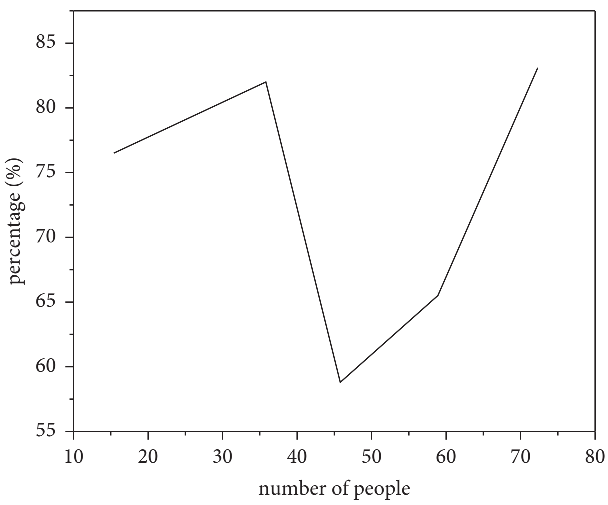

Figure 11: Case explanation and investigation.

that more than 85% of the students think that the teacher's explanation of the case task is very clear in this teaching activity, and 15% of the students maintain an uncertain attitude. The students who think that the teacher's explanation is clear account for 6/7 of the whole class, which shows that the teacher's explanation of this teaching activity is relatively clear, but the teacher should communicate more with the students after class to understand the real ideas of the students.

5. Conclusion

Through the integrated teaching of stem, the construction engineering network education course built in PLS-SEM mode has the mechanism of teaching content display, teaching material expansion, self-test, learning and communication among students, feedback, and evaluation. Students can complete various learning tasks through online education, which is more effective than the systematic learning in the classroom of colleges and universities. They can also learn regardless of time and place, providing more possibilities for learning. This learning method can also fully improve learners' initiative. Through the learning of network platform, students can break the limitations of traditional learning process and make use of diversified network forms and the integration of educational resources. It reduces the bottleneck of education and learning caused by the lack of teachers in the past curriculum teaching, liberates learners from single and monotonous learning, and further improves learners' acceptance and curriculum communication in the learning process. And adopt diversified and multidisciplinary integration to study, strengthen the personalization of the classroom, create a richer learning atmosphere and classroom atmosphere for learners, and strengthen learners' love and participation in the construction engineering course. In addition, in the learning process, it also plays a role in the integration and classification of educational resources by designing the curriculum into different stages. In this way, it improves learners' initiative, cultivates their abilities of independent exploration, independent research, cooperation, and communication, gives full play to the advantages and value of online classroom, promotes the deepening development of stem education model in China, and improves the effectiveness of education curriculum.

Data Availability

The labeled datasets used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

Acknowledgments

This work was supported by the Handan Polytechnic College.

References

[1] S. M. Letourneau, D. Bennett, K. McMillan Culp, P. Mohabir, D. Schloss, and C. J. Liu, "A shift in authority: applying transformational and distributed leadership models to create inclusive informal stem learning environments," *Curator: The Museum Journal*, vol. 64, no. 2, pp. 363–382, 2021.

[2] B. M. Dewsbury, "Deep teaching in a college stem classroom," *Cultural Studies of Science Education*, vol. 15, no. 1, pp. 169–191, 2020.

[3] A. E. Du Plessis, "The lived experience of out-of-field stem teachers: a quandary for strategising quality teaching in stem?" *Research in Science Education*, vol. 50, no. 4, pp. 1465–1499, 2020.

[4] S. Zhao, M. Hu, Z. Cai, Z. Zhang, T. Zhou, and F. Liu, "Enhancing Chinese character representation with lattice-aligned attention," *IEEE Transactions on Neural Networks and Learning Systems*, pp. 1–10, 2021.

[5] A. H. Jones, "What is an educational good? theorising education as degrowth," *Journal of Philosophy of Education*, vol. 55, no. 1, pp. 5–24, 2021.

[6] P. J. Woodford, "Philosophy in the science classroom: how should biology teachers explain the relationship between science and religion to students?" *Cultural Studies of Science Education*, vol. 15, no. 4, pp. 937–950, 2020.

[7] T. Dolighan and M. Owen, "Teacher efficacy for online teaching during the covid-19 pandemic," *Brock Education Journal*, vol. 30, no. 1, pp. 95–116, 2021.

[8] A. Verma, S. Verma, P. Garg, and R. Godara, "Online teaching during covid-19: perception of medical undergraduate students," *Indian Journal of Surgery*, vol. 82, no. 3, pp. 299-300, 2020.

[9] M. V. Rodic and D. D. Rodic, "Plans vs reality: reflections on chemical crystallography online teaching during covid-19," *Journal of Chemical Education*, vol. 97, no. 9, pp. 3038–3041, 2020.

[10] S. Zhao, M. Hu, Z. Cai, and F. Liu, "Dynamic modeling cross-modal interactions in two-phase prediction for entity-relation extraction," *IEEE Transactions on Neural Networks and Learning Systems*, pp. 1–10, 2021.

[11] J. Hermanns, B. Schmidt, I. Glowinski, and D. Keller, "Online teaching in the course "organic chemistry" for nonmajor

chemistry students: from necessity to opportunity," *Journal of Chemical Education*, vol. 97, no. 9, pp. 3140–3146, 2020.
[12] J. Huang, "Successes and challenges: online teaching and learning of chemistry in higher education in China in the time of covid-19," *Journal of Chemical Education*, vol. 97, no. 9, pp. 2810–2814, 2020.
[13] Y. H. Hu, "Effects of the covid-19 pandemic on the online learning behaviors of university students in taiwan," *Education and Information Technologies*, vol. 27, no. 1, pp. 469–491, 2021.
[14] J. Dancy, "Honing practical judgement," *Journal of Philosophy of Education*, vol. 54, no. 2, pp. 410–424, 2020.
[15] W. Small, "Practical knowledge and habits of mind," *Journal of Philosophy of Education*, vol. 54, no. 2, pp. 377–397, 2020.
[16] R. Bell, "Underpinning the entrepreneurship educator's toolkit: conceptualising the influence of educational philosophies and theory," *Entrepreneurship Education*, vol. 4, no. 1, pp. 1–18, 2021.
[17] R. Curren, "Peters redux: the motivational power of inherently valuable learning," *Journal of Philosophy of Education*, vol. 54, no. 3, pp. 731–743, 2020.
[18] K. Takayama, "Engaging with the more-than-human and decolonial turns in the land of shinto cosmologies: "negative" comparative education in practice," *ECNU Review of Education*, vol. 3, no. 1, pp. 46–65, 2020.
[19] M. D. Burbank, M. M. Goldsmith, J. Spikner, and K. Park, "Montessori education and a neighborhood school: a case study of two early childhood education classrooms," *Journal of Montessori Research*, vol. 6, no. 1, pp. 1–18, 2020.
[20] V. Giannakakis, "Neoliberalism and culture in higher education: on the loss of the humanistic character of the university and the possibility of its reconstitution," *Studies in Philosophy and Education*, vol. 39, no. 4, pp. 365–382, 2020.
[21] S. Sturm, S. Ceder, Towards a posthuman theory of educational relationality. abingdon; New York, ny: routledge," *Studies in Philosophy and Education*, vol. 39, no. 4, pp. 447–451, 2020.
[22] S. Goodchild, "Book review: the philosophy of mathematics education today," in *Educational Studies in Mathematics*, paul ernest, Ed., vol. 103, no. 1, pp. 109–119, 2020.
[23] C. Martin, "Educational justice and the value of knowledge," *Journal of Philosophy of Education*, vol. 54, no. 1, pp. 164–182, 2020.
[24] S. Laugier, "Film as moral education," *Journal of Philosophy of Education*, vol. 55, no. 1, pp. 263–281, 2021.
[25] C. Robertson, Z. Al-Moasseb, Z. Noonan, and J. G. Boyle, "The 3-d skills model: a randomised controlled pilot study comparing a novel 1–1 near-peer teaching model to a formative osce with self-regulated practice," *Medical Science Educator*, vol. 31, no. 6, pp. 1789–1801, 2021.
[26] H. Bardesi, A. Al-Mashaikhi, A. Basahel, and M. Yamin, "Covid-19 compliant and cost effective teaching model for king abdulaziz university," *International Journal of Information Technology*, vol. 13, no. 4, pp. 1343–1356, 2021.