The Student-Centered STEM Learning Model Based on Artificial Intelligence Project: A Case Study on Intelligent Car

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Abstract—Artificial intelligence has become a crucial technology for the development of the times. In the practice of emerging engineering education about artificial intelligence, how to enhance students' understanding of artificial intelligence technology, strengthen students' enthusiasm for learning, and improve their innovation ability is a key issue. This research constructs a novel Student-Centered STEM Learning Model (SC-STEM-LM), compensating for engineering students' lack of innovative practice in high education. First, students use real projects as the background to find technical literature and make learning plans. Then, they carry out four STEM learning activities at the same time in cooperation. Finally, the students cultivate their innovation ability by improving the performance of the project. Furthermore, taking the intelligent car target tracking system as an example, we voluntarily recruit ten students with similar abilities from the school of computer science and randomly divide them into two groups (experimental group and control group) to verify the learning effect. In addition, to objectively evaluate the actual effect of the SC-STEM-LM, we also propose a new weighted multi-evaluation algorithm. The results show that the score of the experimental group is 82.84, which is 8.86 higher than the control group.

1 Introduction

Artificial intelligence has become a crucial technology leading future development and is rapidly advancing the process of social intelligence [1]. Researchers' interpretation of the *Development Plans of the New Generation Artificial Intelligence* issued by the Chinese government shows a gap in the development of artificial intelligence in China compared with developed countries [2]. Furthermore, the market has a greater demand for AI talents, and the artificial intelligence education system urgently needs to be improved. Therefore, Educational scholars use artificial intelligence projects to accelerate the reform of learning models, and it is essential to build a new education

system that includes interactive learning, intelligent learning, and project-based learning [3].

At present, a revolution in the innovation of traditional learning models is also emerging in the education field, namely STEM education. It has profound, essential scientific characteristics and wide application technical characteristics. Students use mathematical knowledge to solve engineering problems and then conduct group discussion activities suitable for cultivating engineering students' research and practical abilities [4]. In addition, artificial intelligence technology has also expanded the scope of influence of STEM. The application of educational robots and intelligent teaching aids has built a brand-new educational ecosystem on campus [5].

For these reasons, how to apply STEM to engineering education is a question worth studying. Many scholars have done a lot of research and achieved remarkable achievements. For example, Stuikys et al. [6] introduced a personalized learning framework in STEM-driven computer courses to help improve engineering education. Tang et al. [7] proposed a STEM interdisciplinary integration model based on artificial intelligence technology in China. However, while changing the learning model, we should pay more attention to students' learning interests and innovation abilities. For example, Papadakis [8] used programming methods to create weather forecast applications for smart mobile devices to help students develop advanced cognitive thinking skills effectively. They combined STEM learning with basic programming concepts and successfully responded to the rapid development of the information society.

Therefore, our research objective is to promote STEM and engineering education integration through a student-centered learning model. In addition, we use artificial intelligence projects as examples, hoping to bring students a sense of experience and harvest [9]. In summary, our research aims to solving engineering students' understanding of complex knowledge, enhancing students' learning enthusiasm, and improving their innovative abilities. Our contributions are mainly in the following bullet points:

1. Put forward a novel Student-Centered STEM Learning Model (SC-STEM-LM) based on artificial intelligence projects, which improves students' problem-solving skills, and innovative abilities.
2. Designed a new weighted multi-evaluation algorithm to measure the learning effects of students in different stages.

The rest of this paper is structured as follows. Section 2 introduces the theoretical framework and research status. Section 3 presents the scope and the learning model's design and provides a new weighted multi-evaluation algorithm. Section 4 designs the project structure and the students' work in detail. Section 5 analyzes and discusses the experimental results. Section 6 is the conclusion, which summarizes the research conclusion and the existing problems of this paper, and puts forward the improvement direction of the further study.

2 Literature review

This section gives a theoretical framework and then analyzes the research status to clarify our research problem and objective.

2.1 Theoretical framework

STEM is essentially a multidisciplinary curriculum that integrates science, technology, engineering, and mathematics. It is not a simple superposition of knowledge but an education method that requires a deep integration of interdisciplinary knowledge. To achieve the research objective, the development of the STEM learning model should have the following four characteristics [10]: (1) project-driven as the orientation; (2) interdisciplinary knowledge as the core; (3) frontier science and technology as the support; (4) cooperation Inquiry is a form. For example, Birzina et al. [11] recommend using real cases and projects to increase students' interest in solving problems creatively integrating STEM content. In addition, Almulla [12] thinks There is a significant relationship between project-based learning and collaborative learning, iterative learning, and subject learning. It improves student participation through information sharing and discussion. Based on the above two aspects, we propose a basic theoretical framework, as shown in Fig. 1.

The learning process is roughly divided into four aspects: problem-driven, project design, practical application, and project evaluation. Learners carry out learning activities around specific themes and use various tools and resources to form a learning community. Moreover, our research further promotes the integration of STEM and artificial intelligence education on this basis.
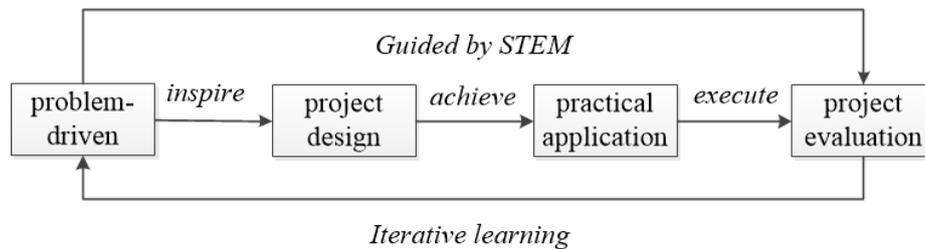

Fig. 1. The project-based learning model with the STEM theory

2.2 Research status

Since the *NMC Horizon Report 2017 Higher Education Edition* was published, more and more research aims to develop STEM blended learning models. Some experts even pointed out that STEM will become a critical factor in promoting the development of school education [13]. Therefore, we have analyzed the relevant research progress at home and abroad since 2017.

Most reviews on STEM are positive. However, Yanez et al. [14] believe that North American schools are eager to adopt STEM reforms, obscuring the ecological, moral, and social conditions students face daily. In addition, the main reason for students to complete courses is learning interest, and the government's measures to increase student participation in learning by committing to provide high-quality courses are inefficient [15]. Thus, relevant policies encourage society and schools to innovate STEM learning models [16]. For example, Cheng et al. [17] proposed a STEM learning model based on design thinking to encourage students to cultivate problem-solving abilities in curriculum design.

At the same time, with the widespread application of new forms of educational technology, educational robots can promote a student-centered collaborative environment [18]. The free and pleasant atmosphere it creates encourages STEM education and enhances the learning process. Togou et al. [19] used Fab Labs (Computer Manufacturing Labs) to prove that learners can be more interested in learning and quickly adapt to the new environment. Dasgupta et al. [20] used an Energy3D (Educational Computer-Aided Tool) learning environment to provide formative feedback to help students understand knowledge. To meet the needs of higher education, Jiang et al. [21] have researched stable parallel algorithms for online computer education and designed a STEM robot model to make it easier for students to understand the execution process of computer algorithms. Therefore, the learning environment can affect students' attitudes. Especially the self-efficacy and learning motivation can also affect future career planning [22].

In the background of the new normal of education, researchers designed learning activities with students as the center [23] and combined various emerging technologies such as gamification [24], digital media, and educational robots, which can effectively improve students' interest and performance. However, experienced teachers have negative feelings about using educational robots in formal courses due to uncertainty [25]. It is necessary to strengthen the investment in new education technology, not just theoretical teaching. In addition, there are few studies on learning models at home and abroad to practice innovative ideas in high education. Consequently, future research should explore different learning models [26] to promote STEM and project-based learning integration.

Inspired by the above research, our research further explored the application model of STEM in engineering education. The problem guiding this research is: enhancing students' understanding of knowledge, strengthening students' learning enthusiasm, and improving their innovative ability.

3   Design of STEM learning model

The beginning of this section describes the research scope and sample selection, then introduces the novel learning model proposed in this research, and finally provides a new weighted multi-evaluation algorithm.

3.1 Scope

Because we design the learning model for educational research, not the regular courses set by the college, therefore, under the premise of not affecting the regular teaching plan, we adopt the method of recruiting volunteers. And then, we select ten students with similar abilities from the enrolled students in chronological order and divide them into two groups evenly. The allocation method is systematic random sampling. They are all third-year students from the school of computer science, with similar ages and engineering backgrounds.

The two groups adopt the SC-STEM-LM and traditional learning model, respectively, under the condition of providing the same experimental equipment and completing the necessary project functions. In addition, two instructors participate in the project's evaluation throughout the whole process without interfering with the student's research. Besides, the duration of project learning is six weeks.

3.2 The student-centered STEM learning model

The SC-STEM-LM is showed in Fig. 2. The learning model mainly contains seven activities, and the relevant explanations are as follows:
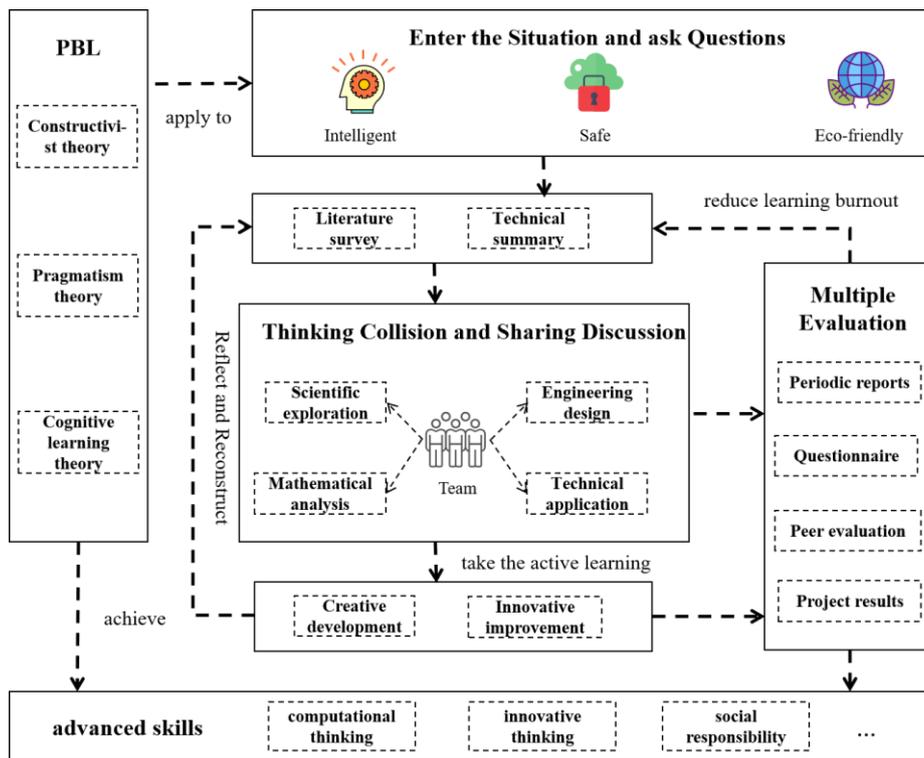

Fig. 2. The student-centered STEM learning model

1. Enter the situation and ask questions (SQ): Students enter an actual project situation in this activity to get an intelligent, safe, and environmentally friendly project experience. In that case, we hope that students can ask in-depth questions to further their knowledge.

2. Literature survey and technical summary (LS): The learning group needs to search relevant literature according to the needs and functions of the project. Then, each student should understand the cutting-edge technical methods, clarify the current problems, and sort out the technical route. Finally, they need to make a learning plan and strictly implement it.

3. Scientific exploration and mathematical analysis (SM): Students should conduct scientific investigations around specific project functions and use mathematical methods to find answers in this learning activity. The purpose of this is to make students understand knowledge and learn to use mathematical language to describe the essential characteristics of the project.

4. Engineering design and technology application (ET): This learning activity is conducted simultaneously with SM. Unlike SM, ET activities pay more attention to students' practical operations. We require students to study in practice, verify the feasibility of theoretical reasoning and obtain the best technical solution.

5. Thinking Collision and sharing discussion (TS): The design of this activity is a bridge between theory and practice. Because both scientific approach and engineering experience should be valued, in that case, students can conduct intense discussions in mutual evaluation to collide with sparks of thinking.

6. Creative development and innovative improvement (CI): This activity is to help students get out of their comfort zone and break through the bottleneck of technology. We try to continuously guide students to get in touch with knowledge in other fields to cultivate innovative and critical thinking. Therefore, students should learn to discover problems, reflect on the results of experiments, and reconstruct their knowledge system.

7. Multiple evaluations and empirical analysis (EA): This activity is to verify the effectiveness of the learning model. Eventually, we hope to achieve the development of students' advanced skills.

3.3 Multiple evaluation

In higher education, the complexity of the learning process brings considerable challenges to the evaluation system. Because traditional evaluation methods are too simplistic, it ignores the cultivation of core literacy in the learning process [27]. For this reason, we incorporate a weighted multi-evaluation algorithm into the STEM learning model, including four aspects: periodic report, questionnaire, peer evaluation, and project results. Similarly, this also applies to traditional project-based learning.

The weighted multi-evaluation algorithm takes students as the main body and examines the learning process with multiple factors, as shown in Table 1. . We can measure learning effects and solve our research problems by evaluating and analyzing instructors, peers, individuals, and project results. To show the final total achieve-

ment, we use a weighted sum algorithm. The proportion of each item is 30%, 20%, 20%, and 30%.

Periodic Reports. There are three rounds of periodic meeting reports from the perspective of instructors. Each group of students reports on the project learning situation separately, which mainly examines the students' understanding of the project knowledge. Then, the instructors evaluate based on the content of the submitted materials and the students' ability to express and summarize and score in five grades from A to E. After three rounds of evaluation, we count the total score of the two learning groups, take the average of the scores of the two instructors and convert them into a hundred-point system to get the periodic reports results.

Table 1. Multi-evaluation of project-based learning

Evaluation Method	Contents	Weights
E1: Periodic Reports	Check the completeness of the document and the content of the writing	30%
	Investigate students' ability to express and summarize	
E2: Questionnaire	Learning interest in the project	20%
	Understanding of subject knowledge	
	Engineering project competencies	
E3: Peer Evaluation	Emotional type	20%
	Cognitive type	
E4: Project Results	The accuracy of the intelligent car to complete the target tracking	30%
Total Achievement	E1 * 0.3+E2 * 0.2+E3*0.2+E4 * 0.3	

Questionnaire. This research uses pretest and posttest questionnaires, which consist of three parts. The design of the questionnaire refers to the development requirements of engineering education for students' competencies [28], [28] and uses Likert's five-point scoring method to count the score, as shown in Table 2. . Consider the process of evaluating the questionnaire is subjective, we pay attention to improving the validity and reliability of the questionnaire as much as possible.

Table 2. Description of the questionnaire

Question	Description	Number of items
Learning interest in the project	Interest in group learning, interest in artificial intelligence, etc.	5
Understanding of subject knowledge	Ideas for programming, ideas for solving mathematical problems, etc.	5
Engineering project competencies [28]	L1: Understand the basic processes required for project design, test, validate, and deliver; L2: Master the methods and tools needed for engineering projects to meet the expectations of the project; L3: Full of teamwork spirit, dare to criticize, question, and innovate; L4: Comply with industry standards, social norms, and engineering ethics.	5

Peer Evaluation. In project-based learning, peer evaluation directly reflects the students' enthusiasm for learning. Some scholars divided the evaluation of text types into emotional types and cognitive types [30], as shown in Table 3. . They believe that the learner's effort in cognitive evaluation is more significant than emotional evaluation. In other words, students who give cognitive evaluations are more engaged in learning. Therefore, each student evaluates the performance of others every week with no restrictions on the content of text types. Finally, we count the effective ratio of peer review texts to reflect students' project-based learning results.

Table 3. Type description of peer evaluation

Dimension	Category	Example
Emotional type	Support	You did an excellent job
	Disapproval	you did too badly
Cognitive type	Point out the error	Your formula for this step is wrong
	Express personal opinions	I think your schematic illustration is well-arranged
	Give suggestions	Try adjusting the learning rate of the network model to 0.01
	Analyze skills	When you do the experiment, your thinking is clear and the operation is standard

Project results. The project results can intuitively reflect the effectiveness of the learning model. Moreover, the actual operation part is significant for the education and training of engineering students.

4 Project architecture and students' work

This section introduces the structure of the artificial intelligence project, focuses on the students' work based on the learning model designed in the previous section, and finally summarizes the STEM group's learning process.

4.1 Project architecture

Our research is driven by the realization of intelligent car target tracking to solve the actual project problems, which benefits from the remarkable achievements of convolutional neural networks in computer vision [31]. Students can be familiar with the evolution process from machine learning to deep learning in SQ activity and promote engineering students' understanding of artificial intelligence technology.

Target tracking projects can be divided into three parts: perception, decision-making, and control. First, the perception module uses camera sensors to identify the surrounding environment and state of the vehicle and extracts picture information as input to the decision-making module. Then, we use the pre-trained neural network model to achieve target detection and combine the tracking algorithm to obtain the output signal of the decision-making module. Finally, the control module drives the motors to rotate according to the output signal to complete the target tracking of the intelligent car.

Hardware Components. The intelligent car is called Jetbot, an open-source intelligent car developed by NVIDIA for researchers to use. Its core embedded motherboard is Jetson Nano, equipped with a quad-core Cortex-A57 processor and 128 NVIDIA Maxwell GPUs, 4GB of LPDDR4 memory, providing 472 gigabytes floating-point computing power. The camera used for image acquisition features a Sony IM219 chip with a resolution of 8 million pixels and a wide-angle field of view of 160 degrees. The power module is a DC voltage of 12V. The movement of the intelligent car is driven by the differential control of the left and right TB6612FN motors, and the follower of the universal bottom wheel cooperates. The hardware components of the intelligent car are flexible and practical and can directly run the Linux system. In addition to the above points, the intelligent car also supports many AI frameworks and TensorRT acceleration functions.

Operating principle. The PC and Jetbot communicate through the local area network. First of all, the car transmits the video data collected by the camera to the PC via wireless signals so that students can view the road conditions on which the car is driving. In the second step, students process each frame of the video in the background of the system and train the neural network model. Finally, students can get the target's label, confidence, and position coordinates to complete the target tracking of the intelligent car. The operating process diagram of the intelligent car sees in Fig. 3.
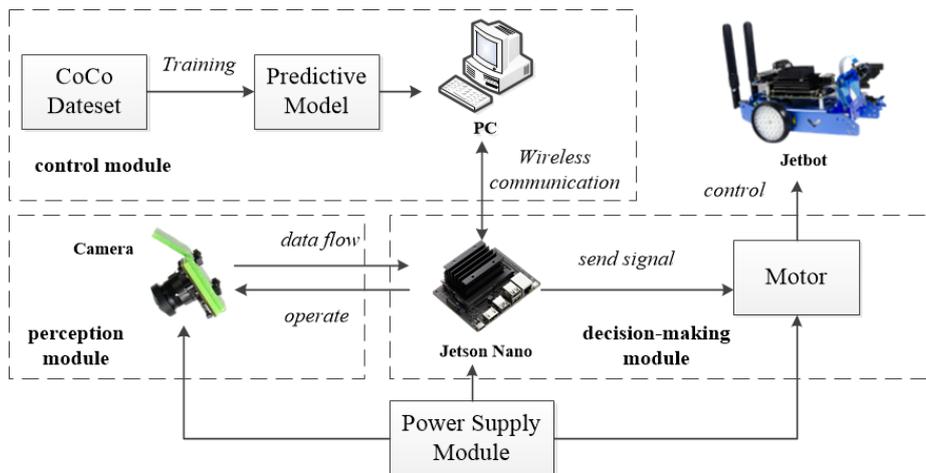

Fig. 3. Operating process diagram of the intelligent car

Experiment Platform. The project uses Python as the programming language. Then, the platform environment is jupyter lab, which supports multiple functional plug-ins. In addition, jupyter lab can be run in the browser or accessed through the client.

4.2 Students' work

According to the project's needs, students choose YOLOv3 to implement the target detection algorithm in LS activity. Because under the same hardware performance, YOLOv3 significantly improves detection speed and accuracy compared to other algorithms [32]. After finding and sorting out relevant technical literature, students enter the SM activity of the SC-STEM-LM. In this activity, students conduct scientific research and mathematical analysis based on the function of the project. One person in the group is responsible for establishing the mathematical model and then drawing the process structure of this sub-project. Next, another person is programming and building a neural network to train the model, including generating the best anchor box and extracting image features. Following that, students construct a loss function and implement a target detection algorithm by solving regression problems.

On the one hand, the above work consolidates the students' existing subject knowledge. On the other hand, simplifying complex project functions into popular mathematical models can deepen their understanding of artificial intelligence technology. In another perspective, the traditional engineering learning methods rely on the machine, and it takes students much time to determine the optimal parameters after repeated iterative attempts. Therefore, the introduction of human participation when solving the optimal strategy of the algorithm, in a human-in-the-loop way, adding intelligent human decision-making can avoid the invalid learning of the machine [33]. The Human-in-the-loop algorithm solution model is shown in Fig. 4.
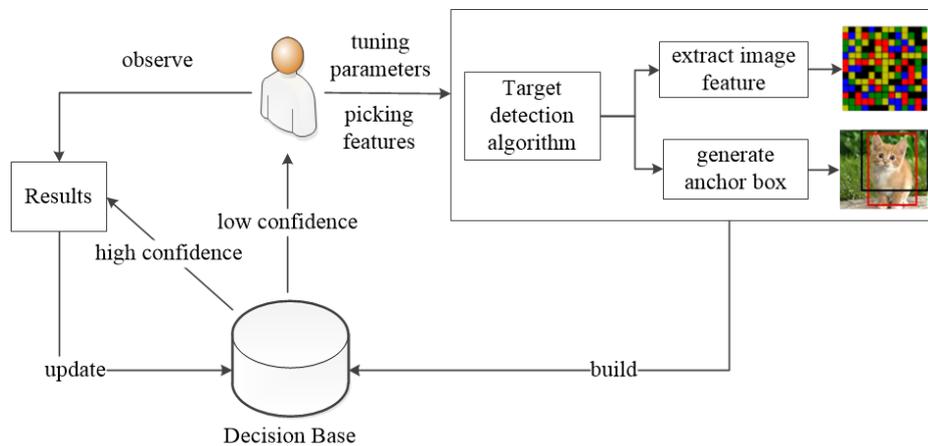

Fig. 4. The human-in-the-loop algorithm solution model

In the ET activity of the SC-STEM-LM, students can control the left and right motor units separately and use the dynamic differential method to realize the car's forward, backward, and left-right steering. The cart moves forward when the speeds of the motors on both sides are the same, and the parameters exceed zero. Otherwise, it moves backward. The core of the target-following algorithm is to make the car always

follow a relative center point. No matter how deviated from the target, the car can always move towards the target.

Through the design and discussion of the target tracking algorithm, the students summarize as a mathematical formula to express the movement principle of the intelligent car:

$$Move_{jetbot} = \{speed + turn_w * center_x \mid speed - turn_w * center_x\}, \quad (1)$$

where $center_x$ is the offset of the horizontal position. Based on the movement of the intelligent car, students scientifically adjust the size of $turn_w$ to find the best parameters suitable for the experimental scene.

After completing the above theoretical analysis, students begin coding on Jupyter Lab. Subsequently, they verify the operation effect of the car in the actual scene. At the same time, other members are responsible for recording, analyzing experimental data, and submitting them in project reports. In the end, under the guidance of the SC-STEM-LM, the students achieve the expected project functions. From the overall learning process perspective, students improve their abilities with the continuous integration and refinement of interdisciplinary knowledge, which serves as the foundation to support the entire project. Meanwhile, the realization of the project also promotes the development of disciplinary knowledge. The design structure of the project is shown in Fig. 5.
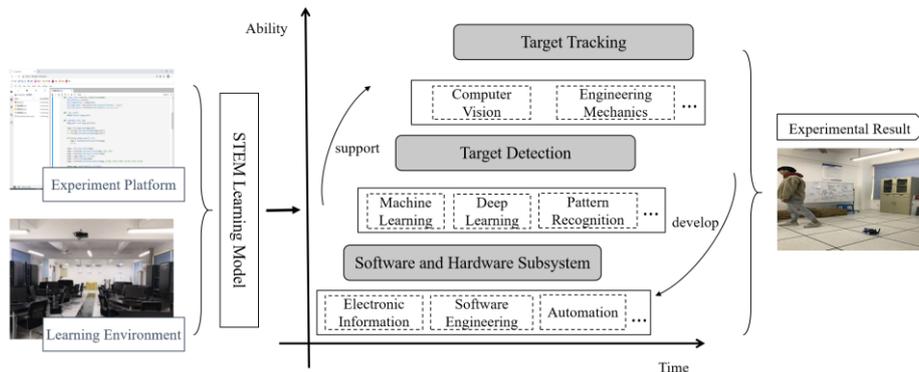

Fig. 5. The design structure of a intelligent car to achieve target tracking

In the CI activity of the SC-STEM-LM, students find that with the rapid switching of scenes, the efficiency of the target detection algorithm cannot satisfy the real-time requirements, and the intelligent car was delayed or lost the target. In addition, the intelligent car realizes the conversion from the input of the deviation value to the actuator's output, but the fast steering makes the movement of the car very stiff. Due to these problems, the STEM group tried redefining the problem and searching for helpful literature to make the car track the target more smoothly. By reconstructing the knowledge system and continuous thinking, they introduced the PID algorithm [34] to solve the intelligent car's insensitivity problem and improve the innovation ability.

4.3 Summary of the student-centered STEM learning model

We summarized the complete learning process as shown in Table 4. .

Table 4. Summary of the student-centered STEM learning model

Learning Activities	Learning Content	Learning outcome
1. SQ	1.1 Enter the situation: The application of artificial intelligence is valuable	To stimulate interest in learning
	1.2 Ask questions: How to achieve the target tracking of the intelligent car	
2. LS	2.1 Search literature: Understand the current mainstream technical methods	To cultivate information awareness and team leadership
	2.2 Set strategy: Assign tasks and list project plans	
3. ET	3.1 Divide the project into three parts：perception, decision-making, and control	To master new technology, cultivate practical ability
	3.2 Assemble the intelligent car and handle the interaction between the devices	
	3.3 Coding: Training a deep neural network model	
	3.4 Doing experiment: Test, record data, and analyze the reason	
4. SM	4.1 Use mathematical language to describe the essence of intelligent car movement	To cultivate problem-solving skills
	4.2 Adjust the speed and steering of the intelligent car by solving mathematical problems	
5. TS	5.1 Communicate and think regularly in the form of a team every day	To cultivate the ability of teamwork
6. CI	6.1 Expand knowledge: Learn more about other fields related knowledge	To cultivate innovative ability
	6.2 Use the PID module in the principle of automation control to improve the intelligent car	
7. EA	7.1 Questionnaire; 7.2 Peer evaluation; 7.3 Periodic reports; 7.4 Project results	To evaluate the effect of learning

We also listed the specific STEM performance as follows:

1. Science: Students cultivated the spirit of collaborative inquiry and information awareness by assembling intelligent cars, collecting relevant documents, and assigning project tasks.
2. Technology: Students designing algorithm models, programming tests, and building deep neural networks Deepen students' understanding of artificial intelligence technology.
3. Engineering: Students cultivate engineering operation ability and stimulate innovative thinking by drawing project flowcharts, analyzing experimental data, and improving project results.
4. Mathematics: Students pass mathematics knowledge assists the implementation of the project, guides the feasibility of the project on a theoretical level, and cultivates the ability of computational thinking and problem analysis.

5 Discussion

This section aims to prove the effectiveness of the newly designed learning model and conduct specific discussions on research issues. We use a weighted multi-evaluation algorithm throughout project-based learning. See section 3.3 for details. This research adopts a quantitative and qualitative hybrid analysis method. The following content is introduced from four aspects: periodic reports, questionnaires, peer evaluation, and project results.

5.1 Periodic reports

After the first round of scoring, we use the Cohen Kappa [35] coefficient to measure the consistency of the two instructors. The results of the consistency test of the two instructors are shown in Table 5. ($k = 0.5, p < 0.001$), which are statistically significant. Thus, the instructors' evaluation results are credible and belong to moderate consistency.

Table 5. Symmetric measures on scoring of instructors

		Value	Asymptotic Standard Errora	Approximate Tb	Approximate Significance
Measure of Agreement	Kappa	.500	.179	3.333	.001
N of Valid Cases		10	-	-	-

Following that, we count the three rounds of scores of the STEM learning group and the traditional learning group ('A' represents 5 points and decreases in order) and use the average score to reflect everyone's contribution. We plot each group's learning trend under the instructor's evaluation, as shown in Fig. 6. Where "item1" represents the score for the content of the submitted document, and "item2" means the score for the student's ability to express and summarize. We can see from the figure that the students' expression and summary ability are on the rise. Fortunately, judging from the research results of the learning pyramid, students' expressive ability (saying) is advantageous in mastering knowledge. It also means that as the project progresses, students' understanding of artificial intelligence technology is also improving, and the experimental group's achievements are significantly better than the control group. However, there is no substantive change in students' abilities from the content of the documents submitted.
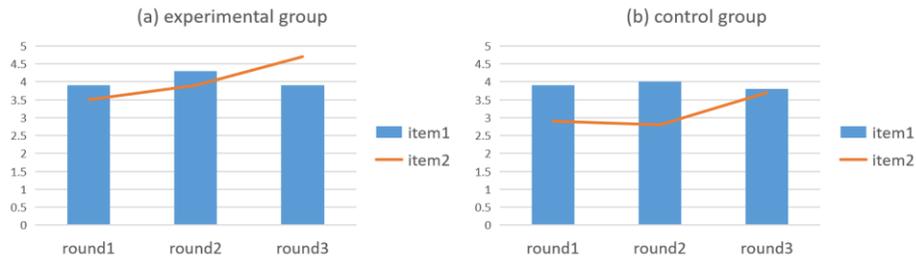
Fig. 6. The learning trend of each group with the evaluation of the instructor

In addition, we also count the scores of each student. Fig. 7 reflects the differences in individual learning. At first, the scores were evenly distributed between 5-9 and then gradually concentrated. No matter how complicated and changeable the process is, it is gratifying that students' performance develops in this promising direction. In particular, the results of the STEM group are more outstanding, which benefits from a good learning atmosphere.
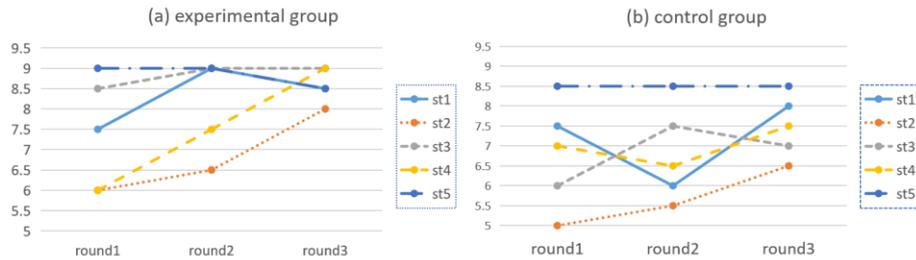

Fig. 7. The scoring trend of each student

5.2 Questionnaire

We perform a paired sample T-test on the experimental group [36]. Table 6. counts the information about students' answers in the pre-and post-test questionnaire, including three aspects and total scores. The post-test score is higher than the pre-test level from students' interest in artificial intelligence projects, and the sample means different and significantly correlated ($p < 0.05$). Next, from the students' understanding of subject knowledge, the post-test score is higher than the pre-test level, and the sample means different and extremely correlated ($p < 0.01$). Moreover, from the students' scores on engineering projectability, the post-test score is significantly higher than the pre-test, which is extremely correlated ($p < 0.01$). Finally, the results show that students' satisfaction is significant within the 95% confidence interval after adopting the SC-STEM-LM.

Table 6. Paired samples T-test on STEM learning group

	Pretest		Posttes		Paired Samples Test		
	Mean	*S.D.*	*Mean*	*S.D.*	*t*	*Sig.*	*Correlation*
Learning interest in the project	14.4	3.975	21.4	2.510	-5.217	.006	.657
Understanding of subject knowledge	14.4	1.673	19.8	1.304	-7.962	.001	.504
Engineering project competencies	13.2	1.924	19.8	.837	-9.731	.001	.652
Totals	42	1.581	61	1.225	-20.028	.000	.486

Similarly, we use the independent sample Test to evaluate the difference in learning effects of different groups, as shown in Table 7. . The results show that the score of the STEM learning group is (61.0±1.23), and the score of the traditional learning group is (57.2±0.84). Therefore, we consider that different learning models have statistically significant differences in student abilities (t'=5.729, p<0.01).

Table 7. T-test results comparing the learning effects of the two groups

Control Group		Experimental group		Independent Samples Test		
Mean	S.D.	Mean	S.D.	t	df	Sig.
57.20	.837	61.00	1.225	5.729	7.066	.001

5.3 Peer evaluation

This research collected a total of 200 feedback messages evaluated by peers. We count the type frequency of each group of submitted and displayed the distribution of each evaluation text with different types of lines, as shown in Fig. 8. We find that students like to give supportive comments that express strong emotions but do not like to give negative comments. There are 25 emotion types in the experimental group and 40 emotion types in the control group. From the evaluation of cognitive types, most students like to express their personal opinions, and the behaviors of giving amendments and pointing out other people's mistakes are relatively small. However, we follow that students' effort on cognitive evaluation is greater than that of emotional evaluation. Therefore, although some students actively completed the evaluation task, they are not deeply involved in the learning. The results showed that the learning interest of the experimental group students was significantly higher than that of the control group.
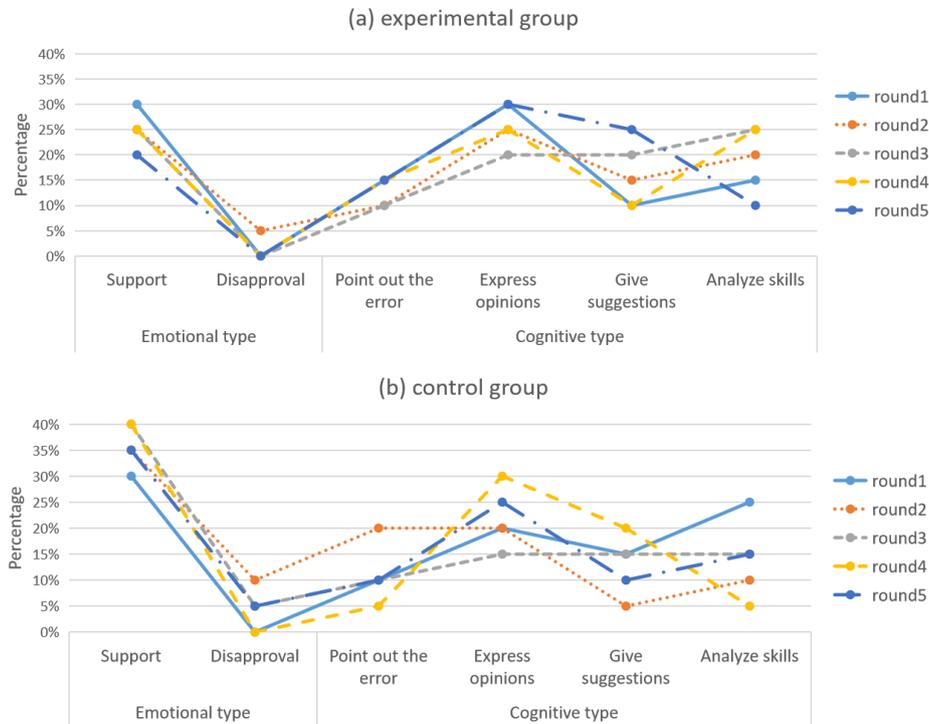
Fig. 8. Distribution of text types in peer evaluation

5.4 Project results

The intelligent car often loses the target in tracking, which requires manual intervention to adjust the car position. Thus, students record the number of human interventions by the intelligent car within one minute, and then according to the formula:

$$Accuracy = 1 - \frac{loss * numbers}{T}, \tag{2}$$

to calculate the accuracy of the target tracking algorithm, where *loss* represents the time, and it takes for people to re-adjust the position of the car. Then, we take the best score after multiple experiments as the score of the project result. Furthermore, through constant trial and error and improvement, engineering students have also discovered the applicable scenarios and defects of the target tracking algorithm. In this way, they can better improve their abilities and deepen their understanding of artificial intelligence technology.

Integrate the above four aspects, and Table 8. shows the results of the weighted multi-evaluation algorithm in the two learning groups. The STEM learning group has certain advantages over the control group, achieving 82.84 points. The empirical analysis shows that the SC-STEM-LM can promote the learning effect of emerging engineering students and improve the application ability of knowledge.

Table 8. The comparative evaluation results of the two study groups

Evaluation Method	Experimental Group		Control Group	
Periodic Reports	average score	80.67	average score	70.33
Questionnaire	satisfaction score	81.33%	satisfaction score	76.27%
Peer Evaluation	percentage of effective copies	75%	percentage of effective copies	60%
Project Results	accuracy	91.25%	accuracy	85.42%
Total score	82.84		73.98	

Our research has shown that the SC-STEM-LM can enhance students' enthusiasm for learning, speed up students' absorption and mastery of knowledge, and promote innovative abilities. From the instructors' evaluation and questionnaire results, since the implementation process of the artificial intelligence project has broken the problem of the original professional courses that are difficult to connect [37], the student's understanding of knowledge has been improved. Furthermore, many scholars responded to the call of the national policy [16]. They widely used educational robots in the context of the new engineering reform [5], prompting students to be more optimistic about the new learning model [9]. Moreover, peer evaluation results show that the blending learning method based on intelligent robots arouses students' enthusiasm and increases their investment in learning. For this reason, more and more research attempts have been shifting towards student-centric [23], so it is essential to establish an environment for creative learning and personalized student development [19].

From the project results, the experimental group has a higher accuracy rate in realizing the target tracking algorithm of the intelligent car, which benefits from the advantages of STEM in the development of innovative capabilities [4]. From another perspective, the experimental group take five weeks to complete the project functions ahead of schedule, bringing more innovation opportunities. In addition, students have reliance and negative thoughts in group learning. Therefore, teachers should assume the role of learning supervisor, enhance communication with students and be aware of the advantages of emerging technologies [25].

Our research believes that the SC-STEM-LM integrates multiple disciplines and uses projects as a carrier to comprehensively use complex and scattered knowledge, conducive to improving engineering students' application and research capabilities. Shortly, educational activities are likely to achieve popularization and humanization of scientific development with the help of artificial intelligence technology [37]. Therefore, we have further explored the application of blended learning models in engineering education.

6 Conclusions

This research realizes the target tracking of the intelligent car by using the SC-STEM-LM. In addition, we have also designed a new weighted multi-evaluation algorithm to measure students' learning effects from different angles. In the periodic reports, the instructors fully affirmed the learning effect of the two groups. The STEM

group scored 80.67, which was higher than the control group. In the questionnaire, the satisfaction rate of the STEM group was 81.33%, while that of the control group was only 76.27%. In peer evaluation, two groups of students improved their cognitive participation behaviors, and the performance of the STEM group was prominent. Finally, from the project results, the speed of the STEM group is faster, and the accuracy of the intelligent car tracking algorithm is 91.25%, which is 5.83% higher than that of the control group, which shows that they have strong innovation ability.

Besides the above results, our research elaborates the theoretical framework, such as project theme selection, student work, and multi-evaluation algorithm. However, we still find that individual students have learning burnout because the differences in students' self-efficacy affect their initiative to participate in learning [22]. Improving courses' quality to encourage students to participate in education activities is often inefficient [15]. Therefore, we can enhance students' self-efficacy through gamification [24], digitization, and intelligent devices. In addition, the sample size of this research is relatively small, and the learning model is limited to engineering majors, which are also the directions of follow-up research that need to be improved. Considering that Li of Stanford University launched the "Human-Centered AI initiative," thinking artificial intelligence's sound development needs humanistic guidance [38]. Therefore, we can also use STEAM education as a development path, and students majoring in humanities and arts can also join in the learning.

We have been actively exploring the application model of STEM in engineering education and integrating it into daily teaching. With the popularization of educational technology, we can also expand the scope of this research and encourage more students to join in response to the shortcomings mentioned above. Because for the academic community, it would be an informed decision to introduce intelligent projects or robotic kits into the classroom [39]. This research is of great significance to students' growth and provides an effective practice plan for the theoretical innovation of emerging engineering education.

7 Acknowledgment

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