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Research Article

Application of Mobile Information System in Quality Education of Research Activities

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In order to solve the problems of uneven local educational resources, imperfect comprehensive practice systems, and insufficient teachers in rural schools, this paper proposes a research activity based on mobile information system. The research activities proposed in this paper take STEAM (the acronym of Science, Technology, Engineering, Art, and Mathematics) as the educational concept, carry out local research-based learning (research-based learning, hereinafter referred to as "research-based learning"), and create STEAM research activities suitable for local teaching in combination with the requirements of national education reform to improve students' scientific literacy such as innovation, scientific, and technological level, and independent practice and exploration. The results are as follows: 92% of the students in the experimental group think that STEAM research and learning activities are very interesting and recognize the research and learning process; STEAM research activities have a strong role in promoting the cultivation of students' three abilities and the training of core skills, and the scores are increased by about 50%; the excellent, good, qualified, and unqualified students in the experimental group accounted for 15%, 73%, 12%, and 0%, respectively, while the control group accounted for 6%, 55%, 32%, and 7%, respectively. Through the participation of STEAM research activities, the students' learning attitude has been greatly improved. The practice of STEAM research activities proposed in this paper in the research and implementation institute has achieved remarkable results, which provides experience for Western schools in the follow-up stage of compulsory education to carry out STEAM research activities.

1. Introduction

Today's students are in the era of knowledge explosion, and knowledge updates are coming one after another. STEAM education, with the practice-oriented interdisciplinary education concept as the core, emphasizes students' comprehensive thinking, pays attention to students' ability development, and realizes the visual process of comprehensive thinking from real scene design and problem solving [1]. Since the introduction of the STEAM concept into China, STEAM education subjects have been included in the teaching and examination system in the economically developed eastern regions [2]. At present, a large number of colleges and universities have conducted in-depth research on STEAM education. Primary and secondary schools in economically developed areas have carried out a large number of research-based learning courses on STEAM education concepts in combination with maker center, robot design, and other big data systems. They are located in the central and western regions and gradually integrate STEAM research concepts into primary and secondary school courses to realize the education promotion in local areas. In contrast to the township schools in the western region, there are few studies on the STEAM education research curriculum in the Township Middle Schools in the western mountainous region, and teachers and students lack conceptual understanding of the STEAM research concept, especially the students of Township Middle Schools in remote areas have hardly been exposed to STEAM research activities [3, 4]. Therefore, carrying out STEAM research and learning activities suitable for local development around the junior middle school stage of Township Middle Schools in the western region, on the one hand, makes up for the lack of STEAM research and learning education concept in villages and towns, on the other hand, provides diversified choices for student development centered curriculum education, and meets the localization development needs of Township Middle School Students in the western region. Figure 1 shows the distribution of the mobile information system industry.

2. Literature Review

STEAM research and learning activities take the STEAM education concept as the guiding ideology, take the school rural children's palace independent activity curriculum as the carrier of project construction, and take research-based learning as the way to solve project activities [5]. Starting from the needs of real life and development, by perfecting and solving project problems in real situations, we can cultivate students' scientific literacy, strive to achieve all-round development, and cultivate professionals who meet the needs of national development. Many scholars have discussed how to carry out STEAM research and learning activities and have successively integrated the STEAM education concept with the research-based learning classroom to meet the needs of curriculum reform and student development [6]. Pond and others constructed STEM cases with effective failure theory, constructed ecosystem models with relevant scientific knowledge of high school biology "ecosystem," and discussed how to improve students' self-efficacy through project completion in high school biology teaching [7]. Rodriguez and others took STEAM education as a research perspective and improved students' subject literacy through the construction of biology cases in junior middle school [8]. White and others integrated the STEAM education concept into high school physics classrooms [9]. Kim and others emphasized the key of design thinking through mode construction based on case analysis and also used the "Internet +" background to achieve a great turning point in maker education [10]. Goeltz and others from the perspective of core literacy, combined with the reality and challenges of basic education, explored the cultivation of students' rational thinking and the improvement of comprehensive ability by STEAM research activities from the perspectives of cultural foundation, independent development, and social participation and raised questions about the development status of STEM education [11]. STEAM education is a practical and interdisciplinary comprehensive education integrating five fields of science, technology, engineering, art, and mathematics, emphasizing the cross-border generation of knowledge in multiple scenes. Through the construction of critical thinking to drive innovative thinking, it not only reflects the characteristics of the STEAM curriculum such as synthesis, practice, and activities but also reflects the essential appeal of the STEAM curriculum to return to life, society, and nature. STEAM education advocates rebuilding the classroom to comprehensively improve the quality of education and speed up the training of innovative talents [12, 13]. Research-based learning takes dissatisfaction with water and the pursuit of excellence as the attitude of students to find, ask, and solve problems. Teachers guide students to master the general methods of scientific research and obtain rich and colorful scientific and cultural knowledge and experience through scientific research activities including topics, project design, and work production, so as to complete the promotion of the full implementation of quality education, cultivate students' innovative spirit and practical ability, and change students' learning methods and teachers' teaching methods [14, 15].

The core of STEAM education and research-based learning is to complete the national requirements for students' innovative spirit, practical ability, project solving, and other comprehensive qualities through students' independent construction. Based on this, this paper aims to explore that STEAM research activities suitable for localization in China are an effective way to cultivate students' comprehensive qualities such as innovation, science and technology, and practical ability.

3. Research Methods

3.1. Literature Research Method. Educational literature is the literature with certain historical value and material value for educational research. Through academic resource platforms such as the university library and Eric China HowNet, we can consult the literature related to STEAM education and research. Through the collection, identification, analysis, and sorting, we form a scientific understanding of the preparation of STEAM research activities, deepen the theoretical understanding of "STEAM research activities," fully learn from relevant theories, and provide sufficient theoretical reserves for this study [16, 17].

3.2. Questionnaire Survey Method. Questionnaires were distributed to the implementation objects of the study to provide a reference basis for case design [18]. Before determining the implementation object and the implementation subject, the relevant questionnaires are designed according to the research needs. The data of all the seventh-grade students in a middle school are collected before and after the activity, and the relevant knowledge level and ability development of students are summarized and analyzed. Select two classes with no significant difference to carry out the practice, and randomly number them to form the experimental group and the control group, so as to reduce the experimental error in the process of practice. After the completion of the course case, carry out the course satisfaction questionnaire again and deeply analyze the survey results.

3.3. Practical Research Method. It is proposed to select the biological laboratory and plant base of a school as the research and learning experimental facilities and guide students to participate in this research and learning activity through the combination of centralized evaluation and selecting the minimum gap class. Through the participation, management, observation, practice, and other activities of

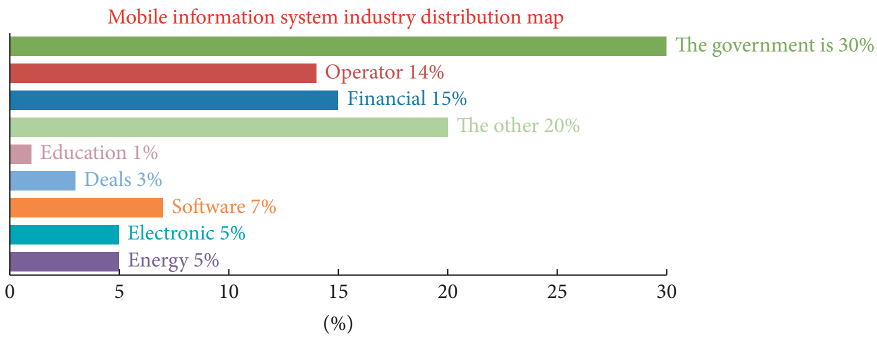

Figure 1: Distribution of mobile information system industry.

the biological experiment base, we can observe and record the on-site situation of teachers and students in the "STEAM research" activity, find out the problems, and conduct research and analysis.

3.4. Data Statistics. Spss26.0, Excel, and other software were used to statistically analyze the reliability and validity of the questionnaire, the test results of students' knowledge level, and the results of ability training [19].

3.5. Comparative Research Method. The comparative research method is to compare and analyze the different performances of the educated in different periods and under different circumstances, so as to reveal the general laws and special performances of education and to summarize the conclusions in line with the objective facts. Through the comparative analysis of the experimental group of students who participated in the research activities and the control group of students who did not participate in the research activities, this study focuses on the improvement of students' comprehensive abilities such as innovation, experimental operation ability, and learning competitiveness by using the research methods of observation and interview, so as to provide effective and accurate theoretical data for this study [20]. The specific research technical route of this paper is shown in Figure 2.

3.6. Evaluation of the Implementation Effect of STEAM Research Activities Based on Junior Middle School Biology. UTOP (UTeach Observation Protocol) is a classroom observation and evaluation tool developed by UTeach Education Research Center for STEM courses in the United States. It mainly includes four dimensions, classroom environment, curriculum structure, implementation effect, and research content, and 27 observation points such as classroom participation, real-time evaluation, and evaluation [21]. UTOP scores 27 observation points by the Likert scoring method of 1–5 points. The lower the score, the less the observation point meets the expectation. This classroom research mainly uses two classroom observations and evaluation dimensions of the classroom environment and implementation effect to make a differentiated comparison of students' participation [22]. A total of five teachers from four disciplines including biology, computer, mathematics, and art were selected as observers to observe the STEAM research activities. After the project activities, the observation data of five teachers were collected for sorting and analysis [23].

In order to further analyze the effect of students' participation in the classroom, the "four rate" observation method is adopted. During the implementation of STEAM research and learning activities, teachers invite school teachers as research and learning secretaries to record the rise rate, interaction rate, participation rate, and satisfaction rate of students and make final statistics after the course [24, 25]. The specific recording method is as follows:

(a) *Head-up rate.* Five important scientific concepts are designed in each project activity (or each class). In the process of practice, the research secretary records and calculates the rise rate, as shown in the following formula:

$$\text{Head rate} = \left(\frac{\text{Up the number of people}}{\text{Total number of classes}}\right) * 100\%. \quad (1)$$

(b) *Interaction rate.* The research secretary records the number of students who actively answer questions in the research process of each project activity (each class). After the project activity (semester), calculate the average number, as shown in the following formula:

$$\text{Interaction rate} = \left(\frac{\text{Number of people who answer the questions voluntarily}}{\text{Total number of classes}}\right) * 100\%. \quad (2)$$

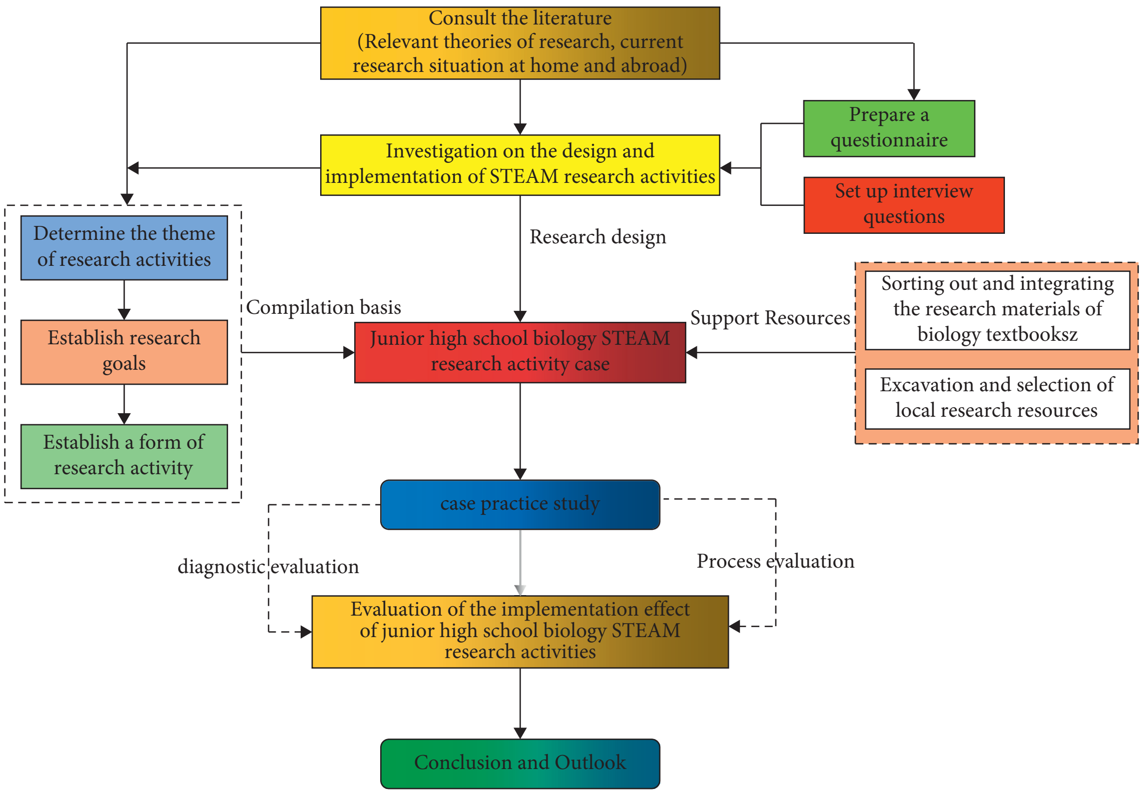

Figure 2: Research technology route.

(c) *Participation rate.* Calculate the participation rate through the learning results, STEAM research manual, after-school exercises, and other data submitted by students, as shown in the following formula:

$$\text{participation rate} = \left(\frac{\text{Number of participants}}{\text{Total number of classes}}\right) * 100\%. \quad (3)$$

(d) *Satisfaction rate.* Design two options of satisfaction and dissatisfaction for anonymous voting, and count the students' satisfaction rate with the classroom according to the students' choice, as shown in the following formula:

$$\text{Satisfaction rate} = \left(\frac{\text{Satisfied number}}{\text{Total number of classes}}\right) * 100\%. \quad (4)$$

4. Result Analysis

4.1. Comparison of "Four Rates" of Students in STEAM Research Activities. As shown in Table 1, before participating in the activity, the rise rate of students was 79.22%, the interaction rate between teachers and students was 80.02%, the classroom participation rate was 79.89%, and the satisfaction rate with conventional courses was 83.40%; after participating in the activities, the student's classroom rise rate was 90.34%, the interaction rate was 90.22%, the participation rate was 92.34%, and the satisfaction rate was 90.25%. The results show that, compared with the conventional courses of biology, the "four rate" participation of students in STEAM research activities is higher, which can better reflect students' active learning and further clarify the good research effect of STEAM research activities.

Table 1: Comparison of "four rates" of students.

Group	Head-up rate	Interaction rate	Participation rate	Satisfaction rate
Before activity	79.22	80.02	79.89	83.40
After activity	90.34	90.22	92.34	90.25

4.2. STEAM Research Activity Satisfaction Analysis. Using the questionnaire to make statistics on the awareness of STEAM research and learning activities, the results are shown in Figure 3. 92% of the students in the experimental group think that STEAM research and learning activities are very interesting, recognize the research and learning process, and look forward to joining similar activity courses again; 78% of the evaluation teachers believe that STEAM research activities can specify curriculum objectives and curriculum contents according to the characteristics of students' physical and mental development, which can greatly promote students' academic achievements; 81% of the students in the control group said that

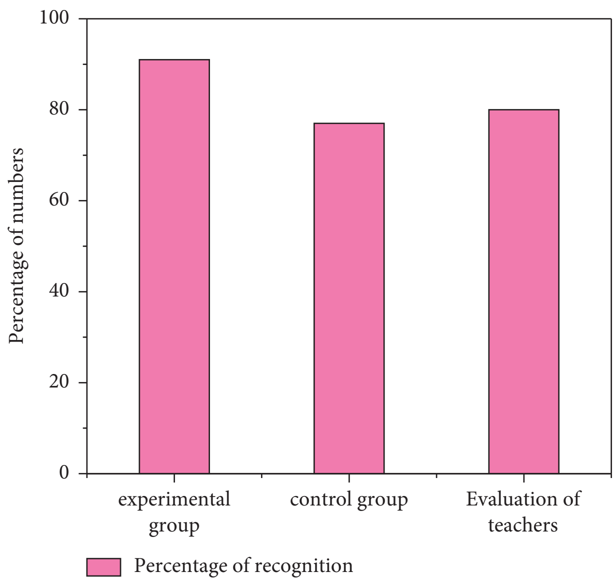

Figure 3: Recognition of STEAM research activities.

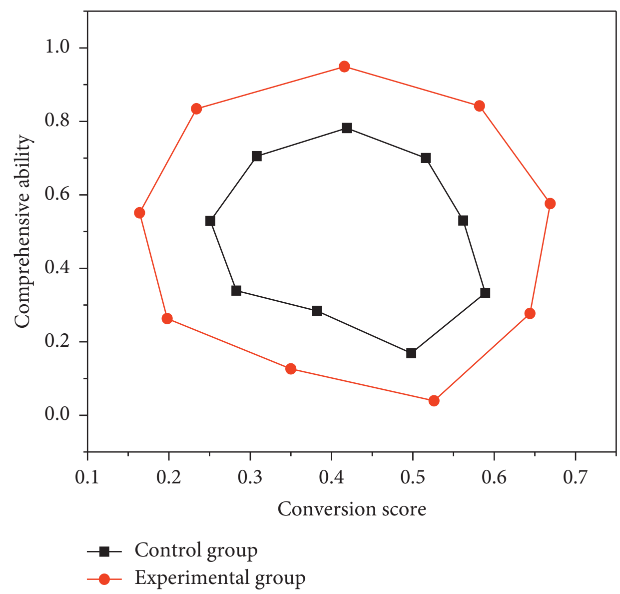

Figure 4: Comparative analysis of students' three abilities.

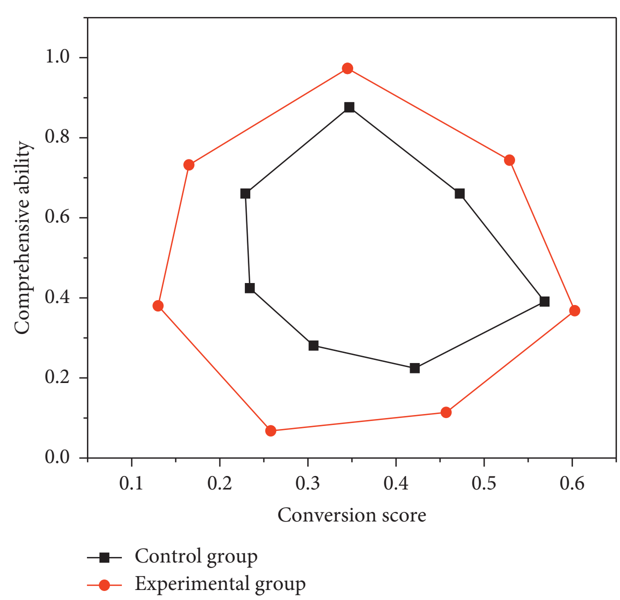

Figure 5: Comparison of students' core skills.

the STEAM research activities were in line with their expectations for the biology classroom learning mode and hoped to have the opportunity to join the STEAM research activities next time.

To sum up, through the project-based learning of STEAM research activities, the recognition of teachers and students in the research and implementation institute for STEAM research activities is higher than that before practice, and the cultivation of students' comprehensive ability is also improved. Teachers' acceptance of STEAM research education is the way, and students' sense of acquisition is more sufficient, which also lays a data foundation for future perfect STEAM research activities.

4.3. STEAM Research Skills

4.3.1. Analysis of Achievement of Three Abilities. After the completion of STEAM research activities, count the average scores of the three ability evaluation forms evaluated by teachers and analyze the achievement of students' three abilities. The statistical results are shown in Figure 4. Compared with the students in the control group, the scores of the students in the experimental group are higher, indicating that the students gradually form project inertial thinking in the systematic STEAM research activities and improve the project operation ability.

4.3.2. Analysis of the Achievement of Core Skills. In STEAM research and learning activities, take STEAM research and learning project activities as the framework to improve students' comprehensive ability, and analyze the basic situation of students' mastering core skills by counting the scores of students' self-rated core skills questionnaire. Among them, the conversion scores of seven abilities, including interpersonal cooperation ability, data mastery ability, communication ability, written expression ability, job creation ability, problem-solving ability, and discussion and summary ability, are 0.37 points, 0.33 points, 0.38 points, 0.29 points, 0.35 points, 0.32 points, and 0.33 points, respectively.

It can be seen from Figure 5 that STEAM research activities have a strong role in promoting the cultivation of students' three abilities and the training of core skills.

4.4. STEAM Research Attitude.

The students' learning attitude is evaluated through four points: classroom observation records (60 points), homework inspection (10 points), questions and answers (10 points), textbook preview notes (10 points), and review outline (10 points). The results are shown in Figure 6.

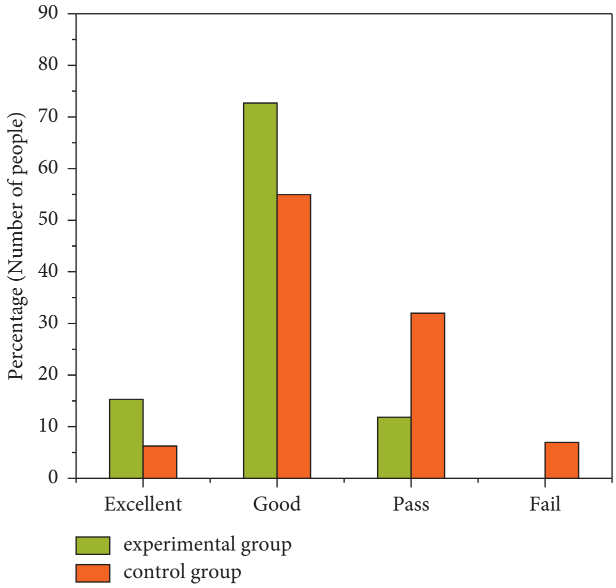

Figure 6: Distribution of students' learning attitude.

The results are shown in Figure 6: the excellent, good, qualified, and unqualified students in the experimental group accounted for 15%, 73%, 12%, and 0%, respectively, while the control group accounted for 6%, 55%, 32%, and 7%, respectively, indicating that the student's learning attitude has been greatly improved through the participation of STEAM research activities. The students in the experimental group completed their homework well, with high content accuracy, clear handwriting, and neat language layout. They can complete the teachers' research and learning requirements in time. They can preview carefully before class, listen carefully in class, and review carefully after class. In addition, the students in the experimental group can also ask the teachers in time to solve puzzles.

5. Conclusion

Based on the compilation and practical research of STEAM research activities in middle school biology, this paper arranges the design principles and design process of STEAM research activities. The results are as follows:

(1) This study combines with real life to promote students' in-depth learning, explore the internal laws of biology through the original biological cognitive structure, obtain the processing ability of words, images, and data, transfer knowledge, and make decisions in a time when solving problems.

(2) In the process of participating in STEAM research and learning activities, middle school students comprehensively use the STEAM concept to solve project tasks and gradually form basic professional qualities when analyzing and practicing project tasks. The professional thinking formed by long-time training contributes to the accumulation of basic knowledge and improves students' basic professional skills.

(3) Traditional courses pay more attention to students' learning results and ignore students' emotional development. In view of this situation, this study constructs and implements STEAM research activities based on the basic knowledge of biology, so as to locate the emotional attitude and value trends of students in the experimental group and the control group.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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