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Research on the Effectiveness of STEM Course in the Language Development of Physics

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ABSTRACT

To explore the influence and effect of STEM curriculum on the development of junior high school students' physical language ability. Methods: A total of 106 students from two classes were randomly identified as experimental group (52 students) and control group (56 students). The experimental group offered STEM courses on the basis of traditional teaching methods, while the control group only taught according to traditional teaching methods, and finally compared the physical language abilities of the two groups. Results: The ability of applying physical language in the experimental group was significantly higher than that in the traditional teaching group (P<0.05). The students' subjective evaluation of language expression, language organization, language logic, language integration and language application ability in the experimental group were better than those in the traditional group. Conclusion: STEM course is more suitable for the development of the times, and its effect is better than traditional teaching. It can combine students' learning with language situations and improve their language application ability.

Keywords: language ability, physics teaching, STEM course.

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I. Introduction

Science must create its own language and concepts for its own use. Physics has a physical language that fits its own discipline for physics workers or learners, organizing and improving their physical language ability is conducive to effective communication and discussion in the learning community. As an important part of physical knowledge, the physical concept is the human brain's highly generalization of the common characteristics and essential attributes of objective things, which is presented through physical language. This process is also the basis and premise for the formation of physical laws, the establishment of mathematical formulas and the improvement of the physical theory system The language in the physics textbook is more incisive and logical, such as concepts, laws, theorems, etc. These languages are not ornate but have extremely strict definitions. Therefore, reading the language in the textbook becomes the premise for students to further study physics, and reading requires students to have the initial physical language ability

In the teaching of the experimental group, the traditional teaching method is used together with the current international popular STEM teaching. In teaching, more emphasis is placed on the expression of students. The teachers provide targeted inspiration and relevant curriculum settings, which stimulate interest in learning and desire to express, improve students' ability to express and describe physical problems, improve students' language ability and expression ability.

II. Method

A. *Process and Method*

106 students from two classes taught by our institute were selected randomly. One class was taken as the experimental group (52 students) and one class was taken as the control group (54 students). The former used STEM teaching based on the traditional methods, and the latter used the traditional methods. Before the experiment, the team checked the basic conditions of the two groups of students, such as their scores, courses, age, gender, teaching materials, class hours, and progress, and there was no difference between two groups (P>0.05).

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B. Teaching Process

The control group: The traditional methods were adopted, with the teacher's teaching as the center. The whole class was dominated by the teacher. The students listened carefully and took notes. After class, they reviewed and consolidated their knowledge. Experimental group: Based on traditional teaching methods, STEM teaching was adopted. Teachers refer to relevant materials, prepare lessons carefully, and formulate appropriate teaching plans according to the requirements of the syllabus. Each STEM class has a special topic. Implementation method: 1). Based on problems encountered in real life and learning, propose a related problem, teachers should prepare STEM lesson examples (related to textbook, highlighting language expression and application), and formulate tasks that students should complete in the teaching process, provide specific cases for students to refer to, and determine the learning objectives. Before class, teach students the methods to find and solve problems, and provide students with rich learning ways (peers, teachers, tablets, computers, teaching references, library materials, etc.). 2). Establish a STEM teaching team with 4-5 people in each group and establish a team leader. The team leader will divide the work and cooperate with the members, and each member is responsible for their own tasks. 3). In the STEM learning stage, students have 2-3 days a week for independent learning, and finally prepare project reports and experience. 4). Discussion and exchange stage, a representative of each group will make a speech to explain the whole process of problem solving; We try not to participate in discussions, but only guide and inspire students to think and solve problems. In view of the shortcomings in the students' presentation process, all groups are comprehensively evaluated and summarized the key physics knowledge in this project. Finally, we will discuss the methods of communication improvement again, and exercise the students' physical language ability again, so that the development of students' language ability can be strengthened.

C. Effect Evaluation

At the end of the course, our team designed the test paper and analyzed the results. Finally, we distributed STEM teaching questionnaires to the experimental group and conducted anonymous questionnaires to the experimental group. A total of 52 questionnaires were distributed, and 52 valid questionnaires were recovered, with a recovery rate of 100%.

D. Statistical Methods

We used SPSS22.0 statistical software to conduct statistical analysis on relevant data. Use (x±s) to represent the measured data, and use ANOVA data, $P<0.05$ indicate t difference is significant.

III. RESULTS

A. Comparison of Examination Results

There was no significant difference between the two groups in the scores of basic physics knowledge ($P>0.05$). Scores of language expression test in experimental group were higher than traditional group ($P<0.05$). It shows that STEM model is superior to traditional model in improving students' language expression, language organization, language logic, language integration and language application ability, and don't affect students' grasp of basic physics knowledge, difficulties, and key points. See Table I for result.

TABLE I: COMPARISON OF SCORES BETWEEN TWO GROUPS (x±s)

Group	N	Basic knowledge	Language Expression
Traditional group	52	64.5±4.12	23.08±2.53★
STEM Group	54	65.3±5.07	24.78±3.47

Note: ★ Comparison between two groups $P<0.05$.

B. Contents and Results of Questionnaire

More than 90.4% of students think that adopting STEM method stimulate their desire for language expression in physics learning, improve their language expression, language organization, language logic, language integration and language application ability, and enhance the application and connection of physical knowledge and language situations. See Table Ⅱ for details.

TABLE Ⅱ: EVALUATION OF STEM TEACHING EFFECT BY STUDENTS IN THE CONTROL GROUP [N (%)]

Survey Options	Remarkable	Commonly	Invalid
Stimulate the desire of physical expression	47（90.4）	3（5.8）	2（3.8）
Ability to describe physics problems in real life	44（84.6）	4（7.7）	4（7.7）
Ability to express physical problems in writing	41（78.9）	5（9.6）	6（11.5）
Demonstrate the ability to solve physical problems	47（90.4）	2（3.8）	3（5.8）
Improve communication ability	45（86.5）	3（5.8）	4（7.7）
Cultivate innovative thinking	42（80.8）	7（134）	3（5.8）
Applied Physical Language Ability	39（75）	9（17.3）	4（7.7）
Integrate physical language ability	40（76.9）	8（15.4）	4（7.7）

IV. DISCUSSION

Traditional model pays attention to theoretical teaching and systematic knowledge, and gradually forms a teaching model that takes teachers' teaching as main body, classroom teaching as the center, students' listening as auxiliary. Traditional teaching stifles students' learning interest and expression desire, hinders students' learning motivation, and is not conducive to developing students' language expression ability. In recent decades, the STEM model has become the trend of teaching reform and education in some disciplines all over the world. Thousands of physics researchers and teachers have started to accept and optimize STEM teaching. Research showed that STEM pays more attention to students' learning. Discussions among members can inspire innovative thinking, and more emphasis is placed on students' active learning and language expression. Teachers only inspire and guide at specific moments. Learning activities become interesting and vivid, and they can easily master professional physical language. Students have deeper understood of physical knowledge, and their language expression ability and ability to describe problems in physical language have also been improved.

The practice of STEM method in physics in this study showed that STEM method has achieved better teaching effect in junior high school physics teaching. The performance and language expression ability of control group were higher than traditional method. The study showed that STEM model is significantly better than the traditional model in improving students' language expression, language organization, language logic, language integration and language application ability, And STEM teaching didn't affect students' grasp of basic knowledge, key points, and difficulties. The survey showed that more than 90.4% of the students in the experimental group feel that STEM teaching can improve their desire to express enhance motivation to learn physics. STEM teaching can improve their ability to describe problems in real life, show physical problems and communicate. The investigation shows that STEM has no outstanding advantages in applying physics language ability and integrating physics language ability in physics teaching.

In terms of teaching effect, STEM model is superior to traditional model: first, the student-centered active learning model of STEM teaching enables students to devote themselves to learning in a loose and independent real situation and solve problems with the help of various resources (networks, peers, books, teachers), which is conducive to improve ability of coordination, cooperation and hands-on. Second, strengthen the connection between physics and life. Theory is more closely related to life, learning form is interesting; Third, it has strengthened the enthusiasm and initiative of learning. Students can review relevant knowledge actively and consult the latest literature and materials in the library and on the Internet to solve problems themselves; Fourthly, it strengthens the students' language expression of physics and consolidates the learning effect; Fifthly, the ability of independent learning has been improved. Through peer discussion and independent learning, students' dependence on teachers has weakened, and their ability of self-study has been improved. By solving problems, they learned how to develop practical ability and connect physics with real life, which is conducive to the development of cooperation and the cultivation of creative ability. Sixth, improve students 'comprehensive quality in physics. In the learning process, strengthening the students' ability to document retrieval and consult data, language expression, independent learning, etc., lays solid foundation for senior high schools and universities to learn physics.

The research showed that there were some shortcomings in STEM teaching; the lack of breadth and depth in physics curriculum design; Teachers have lack of experience and in the exploration stage; Students' original learning habits should be changed. The coherence of knowledge needs reconstruction and lacks the ability to solve real situation problems. STEM model also needs more perfect and scientific means of consideration to comprehensively investigate the effect of STEM course. Teachers should guide students to adapt student-centered learning model, to achieve role switching, from passive learning to autonomous learning. In a word, the introduction of STEM teaching in physics teaching has an obvious effect. Teachers can integrate advantages, essence, and philosophy into physics teaching, give full play to advantages and overcome shortcomings.

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