Research on the Theory of Multiple Intelligences in Training Mode of College Students' Innovative Ability

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Abstract. In today's pluralistic era, the cultivation of comprehensive quality education is being paid more and more attention. With the development of computer technology and artificial intelligence, especially with the advent of the theory of multiple intelligences, the meaning of intelligence is being understood again, provide the feasible thought guidance for the implementation of comprehensive quality education. Applying the theory of multiple intelligences to the subject teaching, the teaching design is aimed at the students' individual intelligence advantage. In the course of teaching, we should pay attention to the use of weak intelligence such as interpersonal communication intelligence and introspection intelligence, in order to promote the all-round, active and individual development of students' multiple intelligences. Through the preliminary experiment exploration on the improvement of teaching quality, we obtain the cultivation mode of college students' innovative ability based on the theory of multiple intelligences after theoretical analysis and experimental verification. It is conducive to create suitable environment to develop multiple intelligence for students, so that students' comprehensive intelligence, innovation consciousness and personality potential can be fully developed, so as to promote the cultivation of College Students' creativity, stimulation of creativity and speed of scientific literacy.

1. Introduction
With the deepening of educational reform and the comprehensive promotion of quality education, the traditional training mode also highlights the drawbacks while achieving excellent results and the cultivation of College Students' innovative ability is attracting more and more attention. Therefore, the cultivation of College Students' innovative consciousness, innovative spirit and innovative ability has become the teaching goal of colleges and universities. How to cultivate college students' innovative ability, to provide better growth environment for college students has become a top priority of university training mode. Through the application of the theory of multiple intelligences, the paper studies the construction of comprehensive quality teaching model and to make up for the shortage of traditional education. Teachers start from the eight intelligences of the theory of multiple intelligences, drive the development of intelligence in the students, the establishment of a variety of teaching organizational forms and enrich their teaching activities. All these will provide teachers with a variety of teaching and organization for the development of student personality intelligence.

2. Analysis on the present situation of college students' innovation ability
At present, the innovation ability of college students in colleges and universities in China is still low, and the innovation ability of college students is mainly reflected in the following aspects:
（1）The prevalence of innovative ability is poor
The college students do not know enough about innovation ability, neglect the cultivation of their own creative cognition ability, and emphasize on what they learn in rote learning, lack understanding of knowledge, and do not attach importance to the cultivation of practical ability and innovation ability, innovation consciousness and the psychological quality is relatively weak.

(2) College students are lacking in creative thinking ability, and poor psychological quality

Many college students are deeply influenced by exams tactics, they are good at the single, positive longitudinal thinking and analysis, and ignoring the training of reverse thinking, which leads to the ways of thinking curing, and thinking divergence and innovation being limited. In addition, the psychological quality of college students is weak, and there is a psychological rejection of innovation, which makes it difficult to cultivate and mold the innovation ability.

(3) College students are lack of innovative practical ability

In the process of practice, college students are too dependent on theoretical knowledge, lack of foresight, and pursuit for the certainty and uniqueness of answers, which seriously hampers the cultivation of College Students' innovative practice quality and the improvement of their innovative practice ability [1].

(4) The innovative ability of "Multiple Intelligences" is extremely scarce and is at a lower level

The exam-oriented education in our country pays too much attention to the cultivation of language and mathematical logic ability, neglects the cultivation of other intelligence abilities of students, and lacks much in the aspects of visual space intelligence, music intelligence, body movement intelligence and so on [2].

3. Multiple intelligences theory

3.1. Definition of Multiple Intelligence

Gardner gives the definition of human multi-intelligence from three aspects. He believes that multi-intelligence is creative ability in the unit or multi-cultural environment, which is the ability of everyone to face problems and solve problems in life, and everyone has the ability to accumulate new knowledge in the process of finding problems and solving problems [3]. Structurally speaking, it is not a kind of ability, but a centralized integration of a set of capabilities. All kinds of capabilities in this set of capabilities do not exist in the form of integration, but exist in the form of relatively independent and mutual equality. That is, eight kinds of intelligence: Language Intelligence, Logical-mathematical Intelligence, Spatial Intelligence, Sports Intelligence, Music Intelligence, Interpersonal Intelligence, Intrapersonal Intelligence, Naturalist Intelligence [2].

3.2. The Characteristics of Multiple Intelligence Theory [4]

Gardner pointed out that to a certain extent, every normal person has multiple intelligences, but everyone has different in intelligence, level and Intelligent combination. Therefore, multiple intelligences regard intelligence as a product of the interaction between biological potential and external environment, which is stable and has inherent characteristics. Its characteristics are mainly as follows [4]:

(1) The possibility of intelligent development

The development of human intelligence is closely related to genetic inheritance, such as the features of human appearance and skin color, but also influenced by family, society and environment.

(2) The uniqueness of intelligent development

Each person has a different intelligence, and each person's intelligence is different, with its own characteristics.

(3) The initiative of intelligent development

Subjective initiative plays an important role in the development of intelligence. The development of individual initiative can give full play to individual potential, so that the individual's intelligence can achieve a high level of development.
3. The plasticity of intelligent development
   To fully explore personal potential, coupled with targeted acquired training and education, personal intelligence is given a higher level of development, thus making the intelligence more malleable.

(5) The continuity of intelligent development
   At the stage of each age, the development speed and intelligence level of each person are different, but through subjective effort and cultivation, its intelligence is also sustainable development.

(6) The predictability of intelligent development.
   Each person's intelligent structure is pluralistic, from "IQ" to "EQ", and then to the research of intelligent multiple structure, which is the deepening of people's understanding of themselves.

4. Construct the teaching mode of multiple intelligences
   The teaching model based on the theory of multiple intelligences is a kind of teaching mode which can guide students to use multiple intelligences to improve the level of students' intelligence. There are three main steps in the operation process of the teaching model based on the theory of multiple intelligences.

   The first step, create an import situation.
   In the process of teaching design, teachers use computer technology, multimedia technology and intelligent technology to create a good learning situation, cultivate students' interest in autonomous learning, and inspire students' ability to discover problems, analyze problems and solve problems [5].

   The second step, select learning methods to discuss and solve the problem.
   Discussion between teachers and students, students adopt independent inquiry learning or collaborative research-type learning methods, and make learning plan, through observation, research and experiment, we work together to explore and solve problems, and finally achieve the purpose of learning [5].

   The third step, results assessment
   In this stage of teaching environment, students can demonstrate their learning results by means of language expression, diagram form, model mode, body movement or music, etc. At the same time, students can also communicate with each other, and then students conduct self-assessment and mutual evaluation of their own performance. Finally, the teacher will give a comprehensive assessment according to the students' performance [6].

   In the multi-intelligence environment, teachers and students cooperate and interact in the basic link of each teaching, and the students' self-monitoring is carried out. It's teaching mode operation flowchart, as shown in Figure 1.

5. Research results and analysis

5.1. Pre-test
   (1) The evaluation of the basic knowledge of computer programming
   Before the implementation of the new teaching model, the students of two classes should be tested on the basic knowledge of computer programming, and the level of mastering the basic knowledge of computer programming in the two classes should be understood. The basic knowledge level of computer programming in the two classes of students before the experiment is shown in table 1.
Table 1 comparison of computer programming level between test class and common class before experiment

| Class          | Number | Average | Standard deviation | Z-test          |
|---------------|--------|---------|--------------------|----------------|
| Test class    | 39     | 74.6    | 12.2               | $Z \approx 1.19 < 1.96$ |
| Common class  | 46     | 72.5    | 10.8               |                |

From the result of Table 1, we can see that there is no significant difference between the test class and the common class student. The students' basic knowledge level of computer programming is basically balanced. Before the experiment, two classes of students were at the same level of knowledge.

(2) Intelligence test

Before the experiment, two class students were tested on the level of multiple intelligences. The content of the test was based on the multiple intelligence assessment table, and two classes of students' multiple intelligence test data, as shown in Table 2.

Table 2 comparison of multiple intelligences between the test class and the common class before the experiment

| Intelligent Project | Score | Test Class | Common Class | Z-test          |
|---------------------|-------|------------|--------------|----------------|
| Language            |       | 8.1        | 7.6          | $Z \approx 1.62 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.76 | 1.1          |                |
| Mathematical Logic  |       | 8.2        | 8.3          | $Z \approx 1.45 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.61 | 0.75         |                |
| Space               |       | 7.1        | 7.0          | $Z \approx 2.54 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.62 | 0.94         |                |
| Body-Movement       |       | 8.0        | 7.7          | $Z \approx 1.76 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.93 | 0.77         |                |
| Music               |       | 8.2        | 8.3          | $Z \approx 1.50 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.55 | 0.75         |                |
| interpersonal       |       | 7.8        | 7.5          | $Z \approx 2.33 > 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 0.74 | 1.0          |                |
| Intrapersonal       |       | 7.2        | 6.7          | $Z \approx 1.72 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 1.2  | 0.94         |                |
| existence           |       | 8.1        | 7.8          | $Z \approx 1.45 < 1.96$ |
|                     | Average |            |              |                |
|                     | Standard Deviation | 1.12 | 1.2          |                |

The results of the experiment showed that the level of knowledge and intelligence of two students were basically consistent. So as to ensure the objectivity and scientific of the selected two classes, avoid the errors which may be caused in the experiment, and improve the accuracy and credibility of the experimental results.

5.2. Experimental Mid-term Test

In the middle of the experiment, that is, the second stage of the experiment, all students in the two experimental classes were evaluated; the teaching plans were adopted by the two classes in the testing process were different, but the content of the test was the same, such as test content and assessment methods. Test data for the second stage, as shown in Table 3.

Table 3 mid-term assessment of test class and common class

| Class          | Number | Average | Standard deviation | Z-test          |
|---------------|--------|---------|--------------------|----------------|
| Test Class    | 39     | 76.5    | 5.4                | $Z \approx 2.07 > 1.96$ |
| Common class  | 46     | 73.2    | 6.6                |                |

Through the evaluation data in Table 3, we can see that the level of the students in the test class master the knowledge is higher than the common class in the first after the first stage of teaching, and the difference between the two classes is relatively obvious. Therefore, the teaching plan is effective and feasible for the test class students in the first stage, and can give full play to the basic ability of students.
5.3. Comprehensive Evaluation After the End of Experiment

After the end of the experiment, the two classes of students carried out the comprehensive test in the written examination and intelligent presentation, and mainly tested the students’ reading comprehension ability, practical operation ability and application innovation ability, etc. The evaluation data is shown in Table 4.

| Class            | Number | Average | Standard deviation | Z-test |
|------------------|--------|---------|--------------------|--------|
| Test class       | 39     | 87.5    | 8.55               |        |
| Common class     | 46     | 79      | 12.71              | Z≈2.69>2.58 |

According to the test data of Table 4, it can be analyzed that the test class students have higher ability to master the basic knowledge of the course than the common class students, and the differences between the two classes are relatively obvious. The result of comprehensive evaluation shows that the practice teaching method can effectively improve achievements in the basic course of program design of the whole class.

Table 5 ability of multiple intelligences to solve problems creatively

| Intellig Project Name value | Language Intelligence | Logical-mathematical Intelligence | Spatial Intelligence | Sports Intelligence | Interpersonal Intelligence | Intrapersonal Intelligence | Naturalist Intelligence |
|-----------------------------|-----------------------|-----------------------------------|----------------------|---------------------|--------------------------|--------------------------|--------------------------|
| Score                       | Average               | Standard Deviation                | Average              | Standard Deviation  | Average                  | Standard Deviation        | Average                  | Standard Deviation        |
| Test Class                  | 9.3                   | 0.43                              | 9.1                  | 0.52                | 7.6                     | 0.95                     | 8.6                      | 0.72                     |
| Common Class                | 8.0                   | 0.66                              | 8.8                  | 0.71                | 7.1                     | 0.66                     | 8.0                      | 1.0                      |
| Z-test                      | Z≈11.67>2.58          |                                   | Z≈3.79>2.58          | Z≈2.93>2.58         | Z≈6.83>2.58             | Z≈10.83>2.58             | Z≈4.57>2.58              |

According to the data analysis in the table, all kinds of intelligence performance of students in the test class in the intelligent project test is obviously better than the common class, and the intelligence difference between the two classes is also relatively obvious. Thus it can be concluded that the teaching mode of the multiple intelligence theory helps the development of students' intelligence level, especially the interpersonal relationships, self-reflection and other disadvantaged intelligence have been significantly improved.

5.4. Analysis of Written Test Results

At the end of the semester, all students in the two classes were tested by written test, with reference to the test scores of the previous two stages, the scores of two different classes of students are compared respectively. Finally, make a summarized evaluation, as shown in table 6.

Table 6 test results of the test classes and common classes

| Class            | Pre-test | Mid-term test | End of the experiment |
|------------------|----------|---------------|-----------------------|
| Test Class       | 74.6     | 76.5          | 87.5                  |
| Common Class     | 72.5     | 73.2          | 79                    |

The trend chart of performance change of the two classes is shown in Figure 2.
The experimental results show that the multi-intelligence-based teaching model can improve the overall development of students' multiple intelligences, and can effectively improve the quality of computer course teaching, and it has obvious effect.

6. Conclusion
The teaching model based on multiple intelligence theory is a training model of the innovative ability of college students. That is to take a different teaching method, starting from a variety of smart projects, a new teaching method which provides students with the opportunity to play their specialty and gives them the advantage of their own to innovate. Students should take different models to participate in learning and carry out various interactive activities. Through the participation of students in a variety of intelligent projects, knowledge and skills of learning will be integrated with each other and infiltrated, so as to tap the potential diversification of students, to construct personalized targeted teaching plan, promote the development of students' specialties, give full play to the advantages of students, and improve the cultivation of students' innovative ability.

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