An Empirical Study on the ARCS Motivation Model in High School Biology Teaching

Mufei Chen[1], Caimao Su[1], Jinchao Lin[2,*], Jiancai Lai[3]
[1]Lingnan Normal University, Zhanjiang, Guangdong, China
[2]Zhanjiang Mechanical and Electrical School, Zhanjiang, Guangdong, China
[3]Zhanjiang Experimental Middle School, Zhanjiang, Guangdong, China
**Corresponding Author*

Abstract: To observe the impact of the ARCS motivation model on students' learning motivation and academic performance in high school biology teaching, this study selected students from two parallel classes with similar learning motivation and academic performance as the research subjects, integrated the ARCS motivation model into the "Genetics and Evolution" course of compulsory biology in high school, and carried out a one-semester teaching practice. After the practice of the ARCS teaching model ended, a before-and-after comparison was made on the basic situation, academic performance and learning motivation level of the students in the two classes. The results showed that integrating the ARCS motivation model into the compulsory biology course in high school could significantly improve the students' academic performance and learning motivation level. The research indicates that compared with the traditional teaching mode, the ARCS motivation model is more conducive to enhancing students' classroom participation, stimulating students' learning motivation, improving students' learning efficiency, and thus enhancing students' academic level.

Keywords: ARCS Motivation Model; High School Biology; Learning Motivation; Academic Level

1. Introduction

Under the background of the deepening reform of education, the country attaches great importance to the cultivation of students' core qualities and personalized development. The "Biology Curriculum Standards for General High Schools (2017 Edition, Revised in 2020)" proposes that high school biology teaching should focus on cultivating students' core qualities such as life concepts, scientific thinking, scientific inquiry, and social responsibility, emphasizing that students should be the main body, and stimulating students' interest in biology learning and internal motivation, which is in line with the basic links of the ARCS motivation model. Integrating the ARCS motivation model into biology teaching can attract students' attention, better stimulate students' learning motivation, enable students to independently carry out learning, freely choose learning modes, and meet the needs of personalized teaching to stimulate students' learning interest[1]. Taking high school biology courses as an example, this paper explores the teaching design based on the ARCS model to improve the effect of high school biology teaching.

ARCS model is an instructional design model proposed by American educational psychologist Keller (1987) to stimulate learners' learning motivation. The four letters in the ARCS model represent attention, relevance, confidence, and satisfaction respectively, and these four elements influence each other and form a whole[2]. This model takes "analysis - design - development - evaluation" as the basic process, focusing on optimizing instructional design to stimulate learners' learning motivation, enabling learners to maintain learning interest, systematically mobilizing students' learning enthusiasm, and ultimately enabling learners to feel the satisfaction of learning and the realization of self-worth. Starting from the "attention" dimension, the ARCS model can effectively reduce the cognitive difficulty of abstract knowledge by using various teaching strategies such as situation creation and problem-driven; by means of the "relevance" dimension, linking application examples of biotechnology in the field of life can

significantly enhance the practical significance of subject content; relying on the hierarchical task design of the "confidence" dimension, it helps students establish a sense of learning efficacy in gradually challenging; through the immediate feedback and achievement display of the "satisfaction" dimension, it strengthens students' learning sense of achievement[3]. This multi-dimensional motivation intervention model highly meets the needs of high school biology for the coordinated development of students' cognition and emotion, and also echoes the concept of promoting the all-round development of students in national education policies.

Currently, there is a phenomenon of imbalance between the disciplinary characteristics and students' learning motivation in high school biology teaching. The problem of insufficient learning motivation among students in real teaching is widespread. Some students are intimidated by the obscure biological concepts and complex experimental operations, and their enthusiasm for classroom participation is frustrated; or due to the lack of close connection between subject content and real life, they lack learning interest, resulting in difficulties in improving knowledge internalization and application abilities[4]. This lack of motivation seriously restricts students' academic level. Therefore, integrating the ARCS motivation model into high school biology teaching is expected to bring hope to resolve the predicament of high school biology teaching.

The ARCS model has achieved certain results in the field of basic education. However, there are still obvious shortcomings in the empirical research on high school biology. First, most studies mainly focus on major disciplines such as Chinese and mathematics, or only stay at the theoretical level to introduce the ARCS model, rarely deeply analyzing the experimental, microscopic and other characteristics of the biology discipline and its adaptability to the ARCS model. On the other hand, existing research mostly focuses on the short-term effects of motivation stimulation, and insufficiently explores key issues such as the dynamic influence mechanism between learning motivation and academic level, and motivation differences among different students. Especially under the wave of curriculum reform oriented by core qualities, there is no widely promoted practical paradigm on how to use the ARCS model to achieve the coordinated improvement of students' learning motivation, subject ability and academic level.

To sum up, this study integrates the ARCS motivation model into high school biology teaching to observe the dynamic impact on high school students' learning motivation and academic level, which is a worthy topic for in-depth research. At the theoretical level, it can open up a new perspective for the application of motivation theory in subject teaching and enrich the cross-research results of educational psychology and subject teaching theory; in practice, by constructing a high school biology teaching design framework based on the ARCS model, it can provide practical motivation intervention strategies for front-line teachers, help solve the teaching motivation predicament, and ultimately promote the improvement of students' learning quality and the all-round cultivation of core qualities, which also highly conforms to the long-term planning of national education policies for talent cultivation.

2. Application Principles of the ARCS Motivation Model

The ARCS motivation model consists of four parts, namely attention, relevance, confidence, and satisfaction, collectively referred to as the ARCS motivation model. The application of the ARCS motivation model in the teaching process is mainly to stimulate students' learning interest and solve students' learning motivation problems[5]. Based on the application principles of the ARCS motivation model, in classroom instructional design, teaching design and implementation are carried out around these four parts. In the classroom introduction session, teachers add content to attract students' attention, attracting students' attention, increasing students' curiosity and desire for exploration, and stimulating students' interest in classroom learning[6]. In addition, teachers associate the knowledge that students have already mastered with the newly taught knowledge in teaching, and relate the knowledge to real life, enabling students to feel the application value of biological knowledge in life, forming a knowledge network system, constructing a knowledge system framework, and ensuring the profundity and systematicness of knowledge learning [7]. At the same time, teachers motivate students through various means in class, improving students' sense of gain in learning,

and enabling students to establish learning confidence. In addition, teachers should also encourage students to actively explore and experience, and through independent thinking and exploration, use knowledge to solve real-life problems, thereby improving students' sense of gain in learning[8].

3. Research Methods

3.1 Research Subjects

This study takes first-year senior high school students from a middle school in Guangdong as the research subjects. It conducts a follow-up survey on students of two parallel classes in this grade, with one class designated as the experimental group and the other as the control group, each consisting of 48 students.

3.2 Data Sources

This study adopted a quasi-experimental design method. The experimental group implemented the teaching method of the ARCS motivation model, and the control group taught in the conventional teaching mode. The teaching durations of the experimental group and the control group were the same, with a course duration of 16 weeks. The teaching content was based on the teaching syllabus of "Genetics and Evolution", the second compulsory course of high school biology published by the People's Education Press. This study adopted a single-blind experimental design. During the entire teaching experiment process, the students in both classes were kept confidential to avoid the influence of any psychological changes. The testers, measurement methods, and measurement tools of the experimental group and the control group were kept consistent. During the process of students filling out the scale, strict confidentiality was ensured to ensure the scientificity and accuracy of the teaching experiment. Before the teaching started, a pre-test was conducted on students' learning motivation and academic level to present the basis of learning motivation and academic level. After the course ended, a post-test was implemented. The same scale was used for learning motivation measurement and a matching test paper was used for academic level. By comparing the results of the post-test and the pre-test, we obtained the changes in students' learning motivation and academic level, and achieved a quantitative evaluation of the impact of the ARCS motivation model-based teaching on senior high school students' learning motivation and academic performance.

3.3 Research Tools

3.3.1 Learning motivation scale

The learning motivation survey used in this study was designed based on Keller's Course Interest Survey[1], referring to the "ARCS Interest Questionnaire" by Chinese scholar Guo[9] and "Constructing an Online Learning System Based on the ARCS Motivation Model" published by Yang[10]. The "Questionnaire on High School Students' Learning Motivation" was designed. The questionnaire consisted of two parts: the first part collected the basic information of the participants, and the second part was based on the four core elements of the ARCS motivation model. The measurement dimensions of learning motivation were divided into attention, relevance, confidence, and satisfaction. The questionnaire contained 16 questions. The Likert 5-point scoring method was used (1 was very inconsistent, 2 was inconsistent, 3 was uncertain, 4 was consistent, 5 was very consistent). The higher the score, the higher the level of students' learning motivation. After pre-testing (n=120), the Cronbach's α value of this scale was 0.825, and the scale reliability was good, so it could be used as the measurement tool for this study.

3.3.2 Biology academic level test paper

This study adopted a parallel test paper design to evaluate the effect of academic level teaching intervention, and used equivalent biology course test papers (Paper A for pre-test and Paper B for post-test) to measure academic level. Both papers were designed based on the "Biology Curriculum Standards for General High Schools", covering the same cognitive dimensions (20% memory, 40% understanding, 40% application), with the same question type structure (40% multiple-choice questions + 60% non-multiple-choice questions, a total of 21 questions) and using a 100-point scoring system. Equivalence was verified through pre-testing (n=120). The independent sample t-test showed that there was no significant difference in the difficulty of Paper A and Paper B (Paper A M=79.35; Paper B M=78.60, $p = 0.432 > 0.05$), and the difference value of the difficulty coefficient was $|\Delta|=0.01$ (the difficulty value of Paper A was 0.794; the difficulty value of Paper B was 0.786). The Cronbach's α value of Paper

A was 0.82, and the Cronbach's α value of Paper B was 0.84. The reliability of both test papers reached the measurement standards, meeting the measurement requirements and the statistical premise for direct comparison.

3.4 Instructional Design Based on the ARCS Motivation Model

The biology teaching model based on the ARCS motivation model is divided into three stages: pre-class guidance, classroom exploration, and after-class improvement.

3.4.1 Pre-class guidance

The primary objective of pre-class guidance is to stimulate students' learning motivation, with a specific focus on the "A" (Attention) dimension of the ARCS motivation model. Pre-class learning resources were curated, and targeted learning tasks were assigned to students in advance. Students were expected to preview the course content, access the pre-provided resources, complete tiered learning tasks, and participate in the pre-class assessment. This instructional design not only enabled students to preliminarily familiarize themselves with the core knowledge to be covered in class and fostered their competence in acquiring new knowledge, but also guided them to proactively identify and pose questions.

3.4.2 Classroom exploration

The in-class inquiry phase serves as a period of face-to-face interaction between teachers and students, as well as a stage for the concentrated teaching of knowledge content. First, it involves an in-depth elaboration of key knowledge points, with a focus on the adoption of heuristic and guided flipped classroom teaching methods to explain the difficult and confusing knowledge points collected during the pre-class guidance phase. Second, teachers provide targeted in-class guidance based on the results of the pre-class assessment, and select interesting and engaging learning resources through appropriate strategies to capture students' attention. Third, classroom teaching is organized through teacher-student interactions and peer-to-peer interactions, incorporating collaborative learning and case-based teaching approaches. This enables students to actively participate in classroom activities, effectively absorb knowledge and solve problems, integrate relevant knowledge points, and ultimately stimulate and sustain their learning motivation. This phase primarily aligns with the "R" (Relevance) component of the ARCS motivation model.

3.4.3 After-class improvement

As the phase of personalized independent learning after class, teachers can assign tasks such as problem-solving, discussions, and assessments during this period to expand and extend the knowledge taught in class, thereby helping students consolidate the key knowledge points. Meanwhile, teachers should promptly collect the problems raised by students during the in-class inquiry phase, and revise teaching strategies to refine their instructional approaches.

For students, they continue to utilize online resources to complete after-class tasks assigned by teachers, including assessments, discussions, and reflections. This not only enhances their confidence in learning biology but also embodies the "C" (Confidence) component of the ARCS motivation model. By fulfilling these after-class tasks, students not only reinforce the knowledge acquired in class but, more importantly, achieve further absorption and transformation of the knowledge, enabling them to draw inferences about other cases from one instance. This helps students experience a sense of academic accomplishment, which reflects the "S" (Satisfaction) component of the ARCS motivation model, and exerts a positive effect on sustaining students' learning motivation and improving their academic performance.

3.5 Research Process

This study was carried out from February to June 2025, for one semester, for 16 weeks, with 3 class hours per week, a total of 48 class hours. The experimental group adopted the teaching method based on the ARCS motivation model, integrating the corresponding teaching strategies in aspects of attention, relevance, confidence, and satisfaction into the teaching of the second compulsory course of high school biology. The control group adopted the conventional teaching mode. Both groups were taught by the same teacher, used the same teaching materials, and maintained the same class hours and teaching progress. The research was divided into three stages:

Pre-test stage: One week before the start of the experiment, a baseline level assessment was carried out through a unified learning motivation scale and biology academic level test paper, mainly to check whether there were

significant differences in the initial learning motivation level and academic level of the two classes in biology courses, which helped to determine the suitability of using one class as the experimental group and the other class as the control group for the experiment; in addition, understand the current situation of students' learning motivation and biology scores in the two classes, providing a reference for the upcoming teaching experiment.

Intervention stage: Experimental group: Teachers strictly carried out teaching according to the teaching framework of the ARCS motivation model, and reflected and optimized strategies after each class. Control group: Adopted the conventional teaching method without deliberately using other teaching models.

Post-test stage: After 16 weeks of teaching experiment, measurements were taken on the two classes respectively to measure their learning motivation and academic level in biology courses. The learning motivation scale and Paper B of the biology academic level test paper were used to evaluate data such as the learning motivation and academic level of the two groups of students. This analysis aimed to evaluate the effectiveness of the ARCS motivation model in biology course teaching.

3.6 Analysis Methods

This study used SPSS 28.0 software for data analysis. First, the reliability and validity of the questionnaire were tested. Second, independent sample t-tests, paired sample t-tests, and two-way ANOVA were used to evaluate the results of the experimental intervention. A $p < 0.05$ value indicated a statistically significant difference.

4. Research Results

4.1 Analysis of the Basic Conditions of the Experimental Group and the Control Group before the Experiment

The experimental subjects of this study are the students in two classes of the same freshman year in our school, and the biology course is taught by the same teacher. To ensure the accuracy of the experiment, pre-tests were conducted on the students in both classes and statistical analysis was carried out. The demographic statistics of the two classes are shown in Table 1.

Table 1. Demographic Statistics of the Experimental Group and the Control Group before the Experiment

Demographic information		Control group	Experimental group
Gender	Male	22	22
	Female	26	26
Age	16 years old	25	26
	17 years old	18	19
	18 years old	5	3

According to Table 1, the ratio of male to female students in the two classes is the same. Girls account for 54.17% and boys account for 45.83%. Therefore, it can be judged that there is no difference in gender between the two classes. The students in both classes are between 16 and 18 years old. Although the number of people in each age group in the two classes is different, the age range of the two classes is the same.

4.2 Comparative Analysis Results of the Pre-experiment Test

Before the experiment, the independent-samples *T*-test was used on the pre-test biological learning motivation, its dimensions and academic level of the experimental group and the control group using the SPSS 28.0 statistical software, and the data are shown in Table 2.

According to the data in Table 2, the average learning motivation of the students in the control group is 3.01, and the average value of the experimental group is 2.99. The average academic level of the control group is 79.50 points, and the average value of the experimental group is 79.0 points. The average values of the learning motivation and its various dimensions and academic levels of the control group and the experimental group before the experiment are not much different. In the two-group equivalence t-test, the *Sig.* (two-tailed) values are both greater than 0.05, indicating that there is no significant difference in the biological concept learning motivation and academic level between the control class and the experimental class in terms of statistics. The two groups of students have good homogeneity and meet the conditions for carrying out the experiment.

4.3 Comparative Analysis Results of the Learning Motivation of the Control Group before and after the Experiment

In order to compare and analyze the changes in

the biological learning motivation of the control group before and after the experiment, this study used the SPSS 28.0 statistical software to conduct a paired-samples test on the pre-test and post-test learning motivation data collected from the control group, and the obtained data are shown in Table 3.

Table 2. Comparison of Pre-test Learning Motivation and Academic Level between the Control Group and the Experimental Group (*N*=48)

dimension	Pre-test of the control group (M±SD)	Pre-test of the experimental group (M±SD)	*t*	*Sig.* (Two-tailed)
Learning motivation	3.01±0.12	2.99±0.12	1.120	0.265
Note	3.01±0.20	2.96±0.23	1.067	0.289
Relevant	3.01±0.23	3.03±0.23	-0.335	0.738
Confidence	2.99±0.19	2.94±0.25	1.159	0.249
Satisfied	3.04±0.22	3.01±0.25	0.547	0.586
Academic level	79.50±10.45	79.0±9.51	0.245	0.807

Table 3. Comparative Analysis Results of the Control Group before and after the Experiment (N=48)

Dimension	Pre-test of the control group (M±SD)	Post-test of the control group (M±SD)	t	Sig. (Two-tailed)
Learning motivation	3.01±0.12	3.03±0.12	-0.788	0.435
Note	3.01±0.20	3.01±0.23	-0.123	0.903
Relevant	3.01±0.23	3.04±0.24	-0.504	0.617
Confidence	2.99±0.19	3.02±0.21	-0.829	0.411
Satisfied	3.04±0.22	3.06±0.28	-0.350	0.728

According to Table 3, it can be seen that the mean value of the learning motivation of the control group students after the experiment is higher than that before the experiment, indicating that the learning motivation of students has been improved after learning. However, through the paired samples test, the *Sig.* (two-tailed) values of the learning motivation and its four dimensions are all greater than 0.05, indicating that there is no significant difference in the learning motivation of the control group before and after the experiment. This result shows that under the traditional teaching mode, the biological learning motivation of the control group students has not been effectively improved.

Combined with the analysis of the teaching experiment, it can be seen that the traditional teaching mode often focuses on teacher lectures, emphasizing the instillation of knowledge. The teaching content and methods are relatively single, making it difficult to fully stimulate students' curiosity and exploration desire, and unable to effectively cultivate students' positive interest in learning. Paying attention to the teaching progress and knowledge imparting, it ignores students' emotional experience and individual differences, resulting in poor classroom experience for students. Therefore, the traditional teaching mode has a certain effect on improving students' learning motivation, but there is no significant difference.

4.4 Comparative Analysis Results of the Learning Motivation of the Experimental Group before and after the Experiment

In order to compare and analyze the changes in the biological learning motivation of the experimental group students before and after the experiment, this study used the SPSS 28.0 statistical software to conduct a paired samples test on the pre-test and post-test learning motivation data collected from the experimental group, and the obtained data is shown in Table 4.

According to the data in Table 4, it can be seen that the average value of the biological learning motivation in the post-test of the experimental group is higher than that in the pre-test. After paired samples test, the *Sig.* (two-tailed) values of the experimental class in learning motivation and its four dimensions are all less than 0.01, indicating that there are significant differences in the levels of students in learning motivation and its four dimensions. This result shows that adopting the ARCS motivation model in biology classroom teaching can effectively improve students' learning motivation.

4.5 Comparative Analysis Results of Learning Motivation between the Experimental Group and the Control Group after the Experiment

After the experiment, this study used SPSS 28.0 statistical software to conduct an independent samples T-test on the post-test biological learning motivation data collected from the experimental group and the control group, and the obtained data is shown in Table 5.

Table 4. Comparative Analysis Results of the Experimental Group before and after the Experiment (N=48)

Dimension	Pre-test of the experimental group (M±SD)	Post-test of the experimental group (M±SD)	*t*	*Sig.* (Two-tailed)
Learning motivation	2.99±0.12	3.35±0.11	-14.530	0.000
Note	2.96±0.23	3.60±0.23	-13.979	0.000
Relevant	3.03±0.23	3.26±0.39	-3.144	0.003
Confidence	2.94±0.25	3.28±0.36	-4.890	0.000
Satisfied	3.01±0.25	3.69±0.26	-13.274	0.000

Table 5. Comparative Analysis Results of the Experimental Group and the Control Group after the Experiment (N=48)

Dimension	Post-test of the control group (M±SD)	Post-test of the experimental group (M±SD)	*t*	*Sig.* (Two-tailed)
Learning motivation	3.03±0.12	3.35±0.11	-13.297	0.000
Note	3.01±0.23	3.60±0.23	-12.394	0.000
Relevant	3.04±0.24	3.26±0.39	-3.379	0.001
Confidence	3.02±0.21	3.28±0.36	-4.283	0.000
Satisfied	3.06±0.28	3.69±0.26	-11.443	0.000

It can be seen from the data in Table 5 that the average values of the biological learning motivation of the experimental group students and its four dimensions after the experiment are higher than those of the control group. After independent sample T-tests, the *Sig.* (two-tailed) values of the learning motivation of the experimental group students and its four dimensions after the experiment are all less than 0.001, indicating that there are significant differences in the levels of students' learning motivation and its four dimensions after the experiment.

4.6 Comparative Analysis Results of the Academic Levels of the Control Group and the Experimental Group before and after the Experiment

To compare and analyze the changes in students' academic levels before and after the experiment, this study used SPSS 28.0 statistical software to conduct a two-way analysis of variance on the academic level data. Analysis of variance needs to meet conditions such as "homogeneity of variance, normality, and independence assumptions". In this study, the data of each group are independent of each other. The tests of "homogeneity of variance and normality" of the data are shown in Figure 1 and Table 6.

As can be seen from Figure 1, the vast majority of points of "academic level" can be approximately distributed on a straight line, and the linear trend is obvious. It can be considered that this continuous data approximately follows a normal distribution.

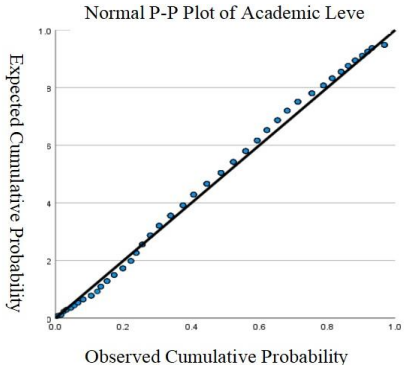

Figure 1. Normal P-P plot of Academic Level

As can be seen from Table 6, the p-value of the homogeneity of variance test is 0.168, which is greater than 0.05. This indicates that the data meet the homogeneity of variance, and the F-test can be used.

In this study, a two-way ANOVA between-subjects effect test was performed on the academic levels before and after the experiment for the control group and the experimental group. The results are shown in Table 7.

As can be seen from Table 7, there was a significant difference among groups (F=5.893, $p < 0.05$, η^2=0.030), indicating the existence of a main effect, and the grouping had a differential relationship with academic level. There was also

a significant difference in terms of time (F=27.689, p< 0.001, η^2=0.128), indicating the existence of a main effect, and time had a differential relationship with academic level. The two-way ANOVA showed that the interaction between grouping and time was significant (F=7.78, p< 0.01, η^2=0.040).The simple effect analysis showed that the academic level of the experimental group in the post-test (90.13±7.63) was significantly higher than that in the pre-test (79.00±9.51, p< 0.001), while the difference in academic level between the post-test (82.92±10.43) and the pre-test (79.50±10.45) in the control group was relatively small (p=0.082). The results indicated that the intervention measures could effectively improve academic level. This suggested that the experimental class adopting the ARCS motivation model for biology teaching was overall superior to the control group adopting traditional teaching methods in terms of enhancing students' motivation and academic level.

Table 6. Test of Homogeneity of Variance of Academic Level

Levene's test of equality of error variances a, b		Levin Statistics	Degree of freedom 1	Degree of freedom 2	Significance
Academic level	Based on the average value	1.704	3	188	0.168
	Based on the median	1.299	3	188	0.276
	Based on the median and with adjusted degrees of freedom	1.299	3	165.363	0.277
	Based on the average value after pruning	1.641	3	188	0.181
Test the null hypothesis that "the error variances of the dependent variable in each group are equal".					

Table 7. Between-Subjects Effect Test

Dependent variable: Academic level						
Source	Type III sum of squares	Degree of freedom	Mean Square	F	Significance	Partial eta squared
Grouping	540.021	1	540.021	5.893	0.016	0.03
Time	2537.521	1	2537.521	27.689	＜0.001	0.128
Group * Time	713.021	1	713.021	7.78	0.006	0.04
Error	17228.917	188	91.643			
Total	1340058	192				
a. R-squared=.180 (Adjusted R-squared=.167)						

Compared with traditional teaching methods, the ARCS motivation model designs a systematic teaching process, integrates diverse teaching strategies to continuously attract students' attention and enhance classroom interactivity; meanwhile, by strengthening the relevance between knowledge and students' real life, students can intuitively perceive the practical value of subject content, thus effectively mobilizing their learning enthusiasm and subjective initiative[9]. Such multi-dimensional motivation intervention not only plays a significant role in enhancing students' learning interest, but also fundamentally promotes the coordinated improvement of learning motivation and academic level.

5. Conclusions and Suggestions

5.1 Conclusions

This study was based on the ARCS motivation model as the theoretical foundation, integrated the ARCS motivation model into high school biology teaching, and observed the impact of the implementation of this model on students' learning motivation and academic level, obtaining the following conclusions:

5.1.1 The ARCS motivation model can effectively enhance high school students' interest in biology learning and stimulate their learning motivation

After adopting the ARCS motivation model for teaching, the learning motivation levels of the experimental group in the four dimensions of attention, relevance, confidence, and satisfaction all increased, and there were significant differences compared with the motivation levels before the experiment. However, there were no significant differences in the motivation levels of the control class adopting the traditional teaching mode before and after the experiment.

5.1.2 Biology teaching based on the ARCS motivation model can improve students'

academic performance and change their learning attitudes

After implementing the teaching mode based on the ARCS motivation model in the classroom, by comparing the post-test data of students in the experimental group and the control group, it is found that the scores of students in the experimental group are higher than those of students in the control group, and there is a significant difference in the scores between the experimental group and the control group. Therefore, the teaching of this mode is helpful for improving students' biology scores.

To sum up, adopting the ARCS motivation model in high school biology teaching is effective and feasible, and it has a great promoting effect on both stimulating students' biology learning motivation and improving their academic level. This teaching mode can attract students' attention in class, enhance students' self-confidence, improve students' interest in learning biology, and thus enable students to gain more satisfaction in biology learning.

5.2 Suggestions

Research has shown that applying the ARCS motivation teaching mode to the second compulsory course of high school biology, students' learning motivation and academic level are significantly better than those of the traditional teaching mode. Teaching based on the ARCS motivation model can enable students to maintain a high level of enthusiasm and motivation for learning. Therefore, this mode has certain guiding value for high school biology teaching and can be promoted on a small scale.

Although the traditional teaching mode has certain value in cultivating some of students' abilities, the significance of its effect is insufficient. However, this does not mean that the traditional mode should be completely abandoned. Instead, through comparative analysis, it is necessary to clarify the gap and improvement space between it and new teaching modes such as ARCS. In actual teaching, the traditional mode can be reasonably selected according to the needs of the teaching scenario, or its reasonable core can be used as a reference for the innovation of other teaching modes to jointly promote the steady improvement of teaching quality.

For courses applying the ARCS motivation mode, motivation strategies need to be flexibly used according to students' learning status. The key to motivation strategies lies in being timely and appropriate, rather than the more times they are used, the better the effect. Teachers should closely monitor students' learning status and flexibly adjust strategies according to the actual situation.

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