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# Research on New Teaching Interaction Mode of High School Mathematics Based on iFIAS Coding System

## -- Taking Three High Quality Maths Courses in Ningxia as an Example

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## Abstract

**Nowadays, as an important way to mobilize the dual subjectivity of teachers and students, more and more teachers are aware of the importance of the concept of curriculum reform and classroom interaction for the success of mathematics teaching. This paper will analyze three high-quality video classes of high school mathematics in Ningxia District through iFIAS, a quantitative research tool Teachers' teaching language style and teacher-student interaction as well as the dynamic characteristic curve of teachers' and students' classroom language are three aspects to summarize the characteristics of classroom interaction in the new teaching of high school mathematics and the existing problems. The purpose is to provide a new perspective of research for deepening the reform of mathematics classroom model, improving mathematics classroom interaction, and achieving the overall improvement of students' mathematical core literacy.**

## Keywords

**iFIAS; High school mathematics; New teaching; Interactive mode; High quality mathematics course.**

## 1. Introduction

The Outline of Basic Education Curriculum Reform (Trial) of China clearly points out that "teachers should actively interact with students and develop together in the teaching process" and "gradually realize the transformation of the presentation mode of teaching content, students' learning mode, teachers' teaching mode and teacher-student interaction mode" [1]. Nowadays, as an important way to mobilize the dual subjectivity of teachers and students, the research significance of classroom interaction mode is not only to change the state of teachers' speeches and monologues, mobilize all favorable classroom cultural factors, create a new mathematical classroom with the cultural characteristics of "independence, cooperation and exploration", but also to implement the educational concept of "all for students", It has become a basic breakthrough to comprehensively improve students' mathematical core literacy [2].

Since the implementation of the new curriculum reform, the classroom teaching reform of basic education in China has made remarkable achievements. Especially in the course of curriculum reform, more and more teachers are aware of the importance of the concept of curriculum reform and classroom interaction for the success of mathematics teaching. High quality courses are the epitome of classroom teaching in a specific period, reflecting the teaching characteristics in different regions and cultural backgrounds, as well as the implementation of curriculum reform plans and concepts.

This research uses the improved Flanders Interaction Analysis System (iFIAS for short) to code and analyze three excellent high school mathematics lessons [3]. Through quantitative research,

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taking the excellent lessons as a mirror, it examines the classroom interaction in teaching recognized by people under the background of the new curriculum in China, and gives some teaching suggestions.

## 2. Research Method

In the 1960s, the American scholar Flanders put forward a kind of classroom behavior analysis technology - Flanders Interaction Analysis System (FIAS). This method is still an ideal research tool for western educational circles to analyze and evaluate classroom teaching behavior and conduct educational research. FIAS divides the language interaction behavior in the classroom into three dimensions: teacher's speech, student's speech, silence or confusion, a total of 10 kinds of situations [4].

In classroom observation, FIAS requires researchers to take samples every 3s, assign a code to each 3s' classroom language activity according to the provisions of the coding system, and fill these codes into the classroom observation record form in chronological order. FIAS classifies the basic teacher-student interaction in traditional classroom teaching, The interactive process of classroom teaching is objectively recorded in the form of coding, but it ignores the behavior of students in classroom teaching, and the handling of silence is not perfect [5]. In the context of the new curriculum, information technology is an indispensable element in classroom teaching, but FIAS cannot reflect this kind of interaction. Therefore, it is difficult to accurately reflect the rich classroom interaction behavior through FIAS analysis. Many scholars have made improvements to the limitations of FIAS.

This paper adopts the Flanders Interactive Analysis Method (iFIAS) improved by Chinese scholars. This method can be used for interactive analysis of classroom teaching including the application of information technology, while preserving some traditional analysis functions of FIAS. The improved Flanders Interactive Analysis System (iFIAS) has improved the 10 coding systems of FIAS into 14 coding systems. On the original basis, the silence situation is divided into silence that is not conducive to teaching and silence that is beneficial to teaching. In the dimension of student language, the discussion between students and peers is added, and the dimension that can reflect the interaction between technology and teachers and students is added [6]. Such treatment is more suitable for current classroom teaching. The iFIAS coding system is shown in Table 1.

**Table 1.** Improved Flanders Interactive Analysis System (iFIAS)

| Classification | | Code | Formulation | |
|---|---|---|---|---|
| Teacher's Language | Indirect impact | 1 | Teachers accept emotions | |
| | | 2 | Teachers praise or encourage | |
| | | 3 | Teachers adopt students' views | |
| | | 4 | Teachers' questions | 4.1Ask open-ended questions |
| | | | | 4.2 Ask closed questions |
| | Direct influence | 5 | Teach by teachers | |
| | | 6 | Teacher instructions | |
| | | 7 | Teachers criticize or maintain teachers' authority | |
| Students' language | | 8 | Student's passive response | |
| | | 9 | Students speak actively | 9.1 Students' active response |
| | | | | 9.2Students take the initiative to ask questions |
| Quiet | | 10 | Discussion between students and peers | |
| | | 11 | Confusion that does not contribute to teaching | |
| | | 12 | Contribute to the silence of teaching | |
| Technology | | 13 | Teacher manipulation technology | |
| | | 14 | Student manipulation techniques | |

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According to the collected classroom videos, the iFIAS coding system is used to sample the classroom teaching every 3 seconds according to the time sampling method. Record the codes in the table in chronological order, as shown in Table 2. There are about 700 to 1000 codes in a class. A record point in the table represents a behavior recorded every 3 seconds. Each horizontal row records 20 behaviors within 1 minute. The vertical column represents the minutes of the course.

**Table 2.** Coding record form

| | 3s | 6s | 9s | 12s | 15s | 18s | 21s | 24s | …… | 60s |
|---|---|---|---|---|---|---|---|---|---|---|
| 1min | | | | | | | | | | |
| 2min | | | | | | | | | | |
| …… | | | | | | | | | | |
| 40min | | | | | | | | | | |

## 3. Analysis of Classroom Teaching Cases

New teaching occupies a large proportion in students' school learning, and its teaching quality directly affects students' learning quality [7]. Therefore, the case selected in this paper is the three new lectures of the excellent mathematics curriculum in Yinchuan City, Ningxia Hui Autonomous Region.

### 3.1. Analysis of classroom interaction structure

The classroom structure analysis data of Case 1-3 can be obtained through statistical analysis, as shown in Table 3:

**Table 3.** Case 1-3 Classroom Structure Analysis Data

| Statistical items | Case 1 | Case 2 | Case 3 | Case 4 |
|---|---|---|---|---|
| Teacher speech ratio | 47.226% | 55.926% | 39.688% | 47.613% |
| Student speech ratio | 17.946% | 17.031% | 28.417% | 21.131% |
| Effective silence ratio | 26.919% | 18.872% | 10.791% | 18.861% |
| Peer discussion proportion | 1.889% | 0.000% | 18.225% | 6.705% |
| Proportion of technology used | 5.903% | 6.214% | 1.439% | 4.519% |

According to the data in Table 3, the classroom structure has the following characteristics:

1. The proportion of teachers' speech in Case 1, Case 2 and Case 3 is 47.226%, 55.926% and 39.688% respectively, which is lower than the norm of Bellick by 68%. The proportion of students' speech is 17.946%, 17.031% and 28.417% respectively. Case 1 and Case 2 are close to the norm of Belek. However, the ratio of the average value of the two is 47.613%: 21.131%=2.25:1, which is far lower than the Belek norm (3.4:1). The results of the above data analysis show that although teachers' speech is still the main part of the classroom, the proportion has decreased significantly compared with the past, indicating that teachers have gradually abandoned the traditional teaching method of "full class" and "talk to the end".

2. The effective silence ratio refers to the ratio of students' practice and thinking in the classroom. The larger the data, the greater the rate of students' autonomous learning in the classroom. The average effective silence ratio of cases 1, 2 and 3 is 18.861%. This data shows that the nonverbal behavior in the classroom still needs to be improved, which is lower than the general standard. The rate of students' autonomous learning is not large enough, which

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requires teachers to actively implement the autonomous exploration, reading self-study and other mathematical learning methods advocated by the new curriculum standard.

3. The proportion of peer discussion in Case 1, Case 2 and Case 3 is 1.889%, 0.000% and 18.225% respectively. It can be seen that the proportion of peer discussion in Case 1 and Case 2 is very low, which shows that the teachers in Case 1 and Case 2 do not pay attention to the cooperative learning of students, which is likely to lead to the decline of students' enthusiasm for learning. The proportion of peer discussion in Case 3 is 18.225%, which shows that Teacher 3 attaches great importance to the importance of cooperative learning in classroom teaching, and students' learning styles in classroom are diversified, which is conducive to giving play to students' learning initiative.

4. The average proportion of technology used in Case 1, 2 and 3 is 4.519%, which is not large. Through in-depth analysis, we can see that in classroom teaching, PPT is mainly used to present teaching content and projector is used to explain and analyze students' homework, reflecting that information technology is only a tool to present teaching content, and teaching is not deeply integrated with information technology.

## 3.2. An analysis of teachers' teaching language style and teacher-student interaction

The positive reinforcement of teachers' language to students includes teachers' acceptance of emotion, teachers' praise or encouragement and teachers' adoption of students' views, while the negative reinforcement refers to teachers' instructions, teachers' criticism or maintenance of teachers' authority. It can be seen from Table 4 that in the three cases, the proportion of indirect and direct effects on students in the teacher's language of the three cases is less than 1, and the average proportion of the three cases is 52.149%, less than 1, indicating that the three teachers are direct in their behavior, and the overall language style of teachers belongs to the direct teaching style.

The teaching process is an interactive process of communication and common development between teachers and students. Teachers should interact with student groups and individual students, and also be regulators of classroom interaction [8]. In the three cases of teacher language, the proportion of positive reinforcement and negative reinforcement to students is more than 1, with an average ratio of 270.926%, far more than 1. This reflects that teachers have a high teaching sensitivity, can accept students' feelings and opinions, actively guide students, and do not rely on criticism, instructions, etc. to organize the classroom. At the same time, it shows that teachers are more inclined to strengthen actively in teaching, and fully tap and use all positive factors in the classroom to promote teaching.

**Table 4.** Analysis data of teachers' tendency or style

| Statistical items | Case 1 | Case 2 | Case 3 | average value |
|---|---|---|---|---|
| The proportion of indirect and direct influence on students in teachers' language | 50. 943% | 67. 010% | 38. 494% | 52. 149% |
| The proportion of positive reinforcement and negative reinforcement to students in teachers' language | 137.778% | 400. 000% | 275. 000% | 270. 926% |

## 3.3. An analysis of students' speech act and teacher-student relationship

Students' classroom language can be divided into passive response, active speech and peer discussion. Active speech refers to students' free expression of their opinions and ideas, and answers exceed the answers to questions. According to the classroom records of the three high-

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quality classes, in Case 1, Case 2 and Case 3, the proportion of students' active speaking accounted for 63.866%, 76.289% and 55.245% respectively, with an average of 65.133%.(Table 5) This shows that students have a high enthusiasm for learning and can actively participate in the classroom. In case 1, case 2 and case 3, the proportion of students' passive speaking accounted for 29.412%, 23.711% and 9.324% respectively, with an average of 20.816%, which was lower than the proportion of students' active speaking. This shows that classroom teaching is under the guidance of teachers, students actively study and explore, and students have the awareness of actively participating in the classroom.

**Table 5.** Case 1-3 Student Speech Behavior Analysis Data

| Statistical items | Case 1 | Case 2 | Case 3 | average value |
|---|---|---|---|---|
| Proportion of active speaking in students' speaking | 63.866% | 76.289% | 55.245% | 65.133% |
| The proportion of passive speaking in students' speaking | 29.412% | 23.711% | 9.324% | 20.816% |

## 3.4. An analysis of the dynamic characteristic curve of teachers' and students' classroom language

In order to study the behavior characteristics of teachers and students in the classroom more systematically and intuitively, the abscissa is used as the time axis, every minute as an interval unit, and the ordinate is used to express the teacher's or student's language ratio in each minute. The teacher's or student's language ratio in each minute in the three cases is depicted on the coordinate map, so as to draw the teacher's or student's classroom language curve. As shown in Figure 1and Figure 2.

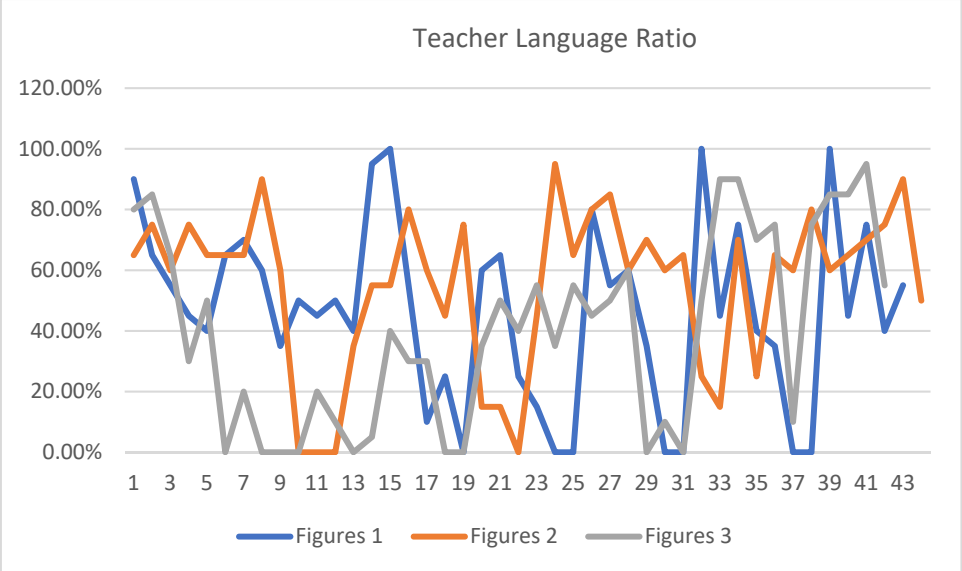


**Figure 1.** Case 1-3 Teacher Language Ratio

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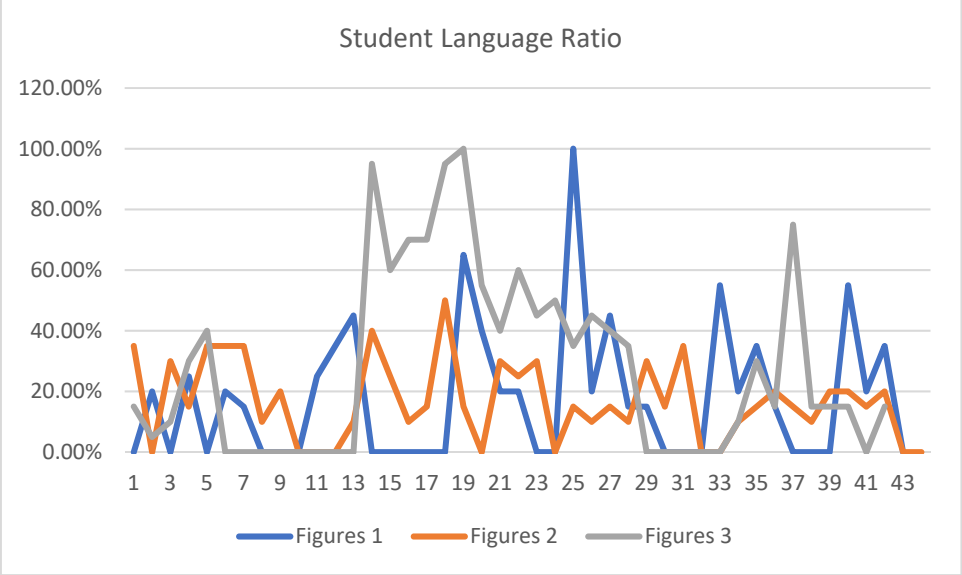


**Figure 2.** Case 1-3 Student Language Ratio

Figures 1 and 2 are the three-dimensional dynamic curves of the teacher's language ratio and student's language ratio of Case 1-3 respectively. By observing Figures 1 and 2, we can clearly and intuitively see the changes of the teacher's and student's language in the classroom. From the teacher's language ratio curve, we can see that the teacher's language ratio is zero for 4, 2 and 6 periods of time respectively in the three classrooms, and the duration is short. It is found from the study of classroom recorded videos that, Students learn independently or through discussion during these periods, and teachers inspect the classroom and give individual guidance according to students' conditions. In the three cases, teacher language almost runs through the whole classroom teaching activities, indicating that teachers play the role of guides and promoters in teaching.

It can be seen from the students' language ratio curve that the dynamic curves of Case 1 and Case 3 both have students' language peaks. The student language ratio curve of Case 2 is relatively flat. There are 9, 6 and 3 sections in the three classes respectively, and the student language ratio is zero for more than ten years. The research video found that in case 1, the teacher was teaching for more than two minutes, and the number of segments with students' language ratio of zero was the largest, while students had less time for autonomous learning. The period of more than two minutes for case and case 3 is for students to learn independently, which shows that students in case 2 and case 3 are not passively accepting learning. Teachers protect students' right to independent thinking, and students' learning styles are diversified. It can be seen from the two figures that there are both teacher language and student language in the classroom, and classroom interaction is frequent, but relatively speaking, the number of interactions between teachers and students in Case 1 is relatively small.

## 4. The Characteristics of Classroom Interaction in The New Teaching of High School Mathematics

### 4.1. Characteristics of classroom teaching interaction

Through the analysis of the above three cases of high-quality courses in Ningxia, it can be concluded that the new classroom teaching interaction model of high school mathematics has the following characteristics:

(1) Harmonious classroom teaching atmosphere

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It can be seen from the fact that the proportion of teachers' speech and the proportion of teachers' positive reinforcement and negative reinforcement to students are greater than 1. In the three cases, teachers actively guide students and encourage them to participate in classroom activities. The language is gentle and persuasive. They do not demand students with orders or criticize students, which shows that teachers tend to actively strengthen in teaching and fully tap and use all positive factors in the classroom to promote teaching, It creates a good classroom atmosphere, which is very conducive to students' learning and helps to improve students' enthusiasm for learning.

(2) Change of teacher's role to collaborator and guide

Teachers can accept students' feelings and opinions in teaching. After students answer, they can adopt students' opinions and give positive evaluation in a timely manner. When students learn independently or communicate with peers, teachers only occasionally guide students' questions without too much intervention. All of the above reflects the change of teachers' concept. Teachers are not only the imparter of knowledge, but also the guide and cooperator of students' learning. Accordingly, The main position of students has been established.

(3) Diversified learning styles of students

Case 2 and Case 3 reflect the way of learning mathematics through cooperation and communication, independent thinking and independent inquiry. It reflects that teachers actively implement the new curriculum concept, pay attention to the main participation of students, and can combine multiple learning methods to promote students' learning.

(4) Step by step guidance of problem string

In general, the teachers in the three cases threw out a series of closely related questions to students, divided complex problems into a series of small problems, mobilized students' enthusiasm in the frequent interaction with students, and helped students understand new concepts and new connotations.

## 4.2. Problems in classroom interaction mode

Through the analysis of three cases, we found that there are many features of classroom teaching interaction worth learning and maintaining, but there are still some problems in classroom interaction in teaching:

(1) The space for cooperative learning needs to be expanded

As an important learning method advocated by the new curriculum, cooperation and communication can help students to take the initiative in learning and enhance the ability of collaboration and communication between individuals. In case 1 and case 2 classroom teaching, there is no teaching activity of students' mutual discussion. Only case 3 has a link of students' mutual discussion, accounting for 18%. It shows that some teachers do not pay much attention to the cooperative learning and independent inquiry of students in the classroom. In general, there is still room for improvement in the use of cooperative learning to promote the development of students.

(2) The deep integration with information technology needs to be strengthened

The new curriculum emphasizes to use scientific calculators and various mathematical education technology platforms as much as possible, strengthen the combination of mathematics teaching and information technology, and encourage students to explore and discover by using calculators and computers [9]. The use of technology in the case is only reflected in the use of slides by teachers and the use of projectors by teachers and students to present the teaching content. It shows that information technology in the classroom is only a display tool, not a research tool for students, and the deep integration of information technology and curriculum is not well realized in the classroom.

(3) We should pay more attention to the cultural value of mathematics

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The new curriculum emphasizes that mathematics culture should be combined with the content of high school mathematics curriculum as much as possible. It can be found from classroom observation that case 2 and case 3 hardly mention the cultural value of mathematics, only case 1 teachers mention "Zhao Shuang String Diagram" to students, and then lead to the meaning of basic inequality. This shows that teachers need to consciously pay attention to the cultural value of mathematics in teaching, so as to improve students' aesthetic perception of mathematics and cultural purport.

This paper analyzes three high-quality video lessons through iFIAS, a quantitative research tool, and summarizes the characteristics and problems of classroom interaction in the new teaching of high school mathematics. It aims to provide a new perspective of research for deepening the reform of mathematics classroom model, improving mathematics classroom interaction, and comprehensively improving students' mathematical core literacy.

## 5. Conclusion

In order to study the characteristics and problems of classroom interaction in the new teaching of high school mathematics, improve the way of classroom interaction, and achieve the goal of comprehensively improving students' mathematical core literacy, this paper takes three high-quality mathematical courses in Ningxia as an example, uses the improved iFIAS coding system to code the words and behaviors of teachers and students in the selected course videos, and then, according to the coding results, conducts classroom interaction structure Through the analysis of the four aspects of teachers' teaching language style, students' speech behavior and the dynamic characteristic curve of teachers' and students' classroom language, it is found that the classroom interaction in the new teaching of high school mathematics has the following characteristics: First, the classroom teaching atmosphere is harmonious; Second, the role of teachers has gradually changed to collaborators and guides; Third, students' learning styles are diversified, from traditional passive learning to cooperative communication, independent inquiry and other forms of development; Fourth, teachers guide students to think step by step through question strings, rather than pouring them in. However, there are still some problems that need to be improved: first, there is insufficient space for students to cooperate and communicate in the classroom; Second, the deep integration of information technology in the classroom still needs to be strengthened, which shows that information technology in the classroom only stays in the view of information technology as a display tool, not as a research tool for students, and the deep integration of information technology and curriculum is not well realized in the classroom; Third, we need to pay more attention to the cultural value of mathematics. Few teachers can pay attention to the mathematical culture, which is of great significance for cultivating students' good quality and rational thinking ability. This requires teachers to pay attention to the cultural value of mathematics consciously in teaching.

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