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# The Research on Constructing Coding for Junior High School Mathematical Wisdom Classroom Teaching Behaviors based on Nvivo 11

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***Abstract:*** This study is based on the characteristics of junior high school mathematics teaching. Combining the Flanders Interaction Analysis System with other improved tools, the research has redesigned the observation indicators and observation forms, covering three aspects: teachers, students, and teaching interactions. Adopting the dual coding proposed by Wu Xiaopeng, the focus is on teaching behaviors such as classroom questioning, answering, feedback, and board work, facilitating in-depth analysis. With the support of Nvivo11 software, a comprehensive teaching behavior coding system has been established, providing effective methods and support for the construction of intelligent mathematics classrooms in junior high schools.

***Keywords:*** Intelligent Classroom; Teaching Behaviors; Coding System

## 1. Theoretical Foundation

In 1963, Flanders first proposed a classroom observation method based on interaction behavior analysis, which was named the Flanders Interaction Analysis System (FIAS) [1]. This method redirected the study of classroom teaching behaviors towards quantitative research. It involved segmenting classroom time into 3-second intervals, making classroom teaching behaviors observable, measurable, and evaluable. Flanders believed that classroom teaching is primarily constructed through language, thus language behavior became the primary manifestation of classroom teaching behaviors. Subsequent research indicated that many subsequent classroom observation scales were improvements upon the Flanders Interaction Analysis System observation scale, and research results confirmed that over 80% of classroom behaviors involve verbal communication between teachers and students [2].

The Flanders Interaction Analysis System observation scale aims to analyze language expressions during the teaching process. According to the source of language expression, the scale divides it into three main primary indicators: teacher language, student language, and silence and confusion (unclear source). Under the primary indicator of teacher language, it is further divided into indirect influence and direct influence as secondary indicators, with ten specific tertiary indicators represented by codes 1, 2, 3...10. For detailed scale content, please refer to Table 1.1.

**Table 1.1 Flanders Interaction Analysis System Observation Scale**

| Category | | Category | Category |
|---|---|---|---|
| Teacher Language | Indirect Influence | 1 | Accepting emotions |
| | | 2 | Encouraging agreement |
| | | 3 | Adopting viewpoints |
| | | 4 | Asking questions |
| | | 5 | Lecturing |
| | Direct Influence 6 Giving instructions | 6 | Giving instructions |
| | | 7 | Criticism |
| Student Language | | 8 | Responding |
| | | 9 | Speaking |
| Silence | | 10 | Ineffective language |

From the data table, it can be seen that out of the ten types of teaching interaction behaviors, seven are teacher-led, and two are student-led. However, there is one behavior that does not have a clear initiator; it is described as a state, referred to as silence/confusion state. The

characteristics of this state make it difficult for observers to accurately understand the situation, thus making it challenging to categorize it into specific behavior types for coding.

This analysis system divides classroom time into short 3-second clips, allowing observers to more accurately assess behaviors in each segment and code them accordingly on the observation scale. With a 40-minute class, this method would generate 800 codes. This approach breaks down complex classroom scenarios into many brief 3-second segments and converts them into coded statistics. Next, based on the 20×40 coding data record table, we extract pairs and organize them into a 10×10 matrix for data analysis. Finally, through matrix analysis, ratio analysis, curve analysis, and other methods, we ultimately derive the characteristics of verbal interaction between teachers and students. This method has significant structured and quantitative characteristics, which are crucial for analyzing classroom structure and teaching trends. The specific operational process can be seen in Figure 1.1.

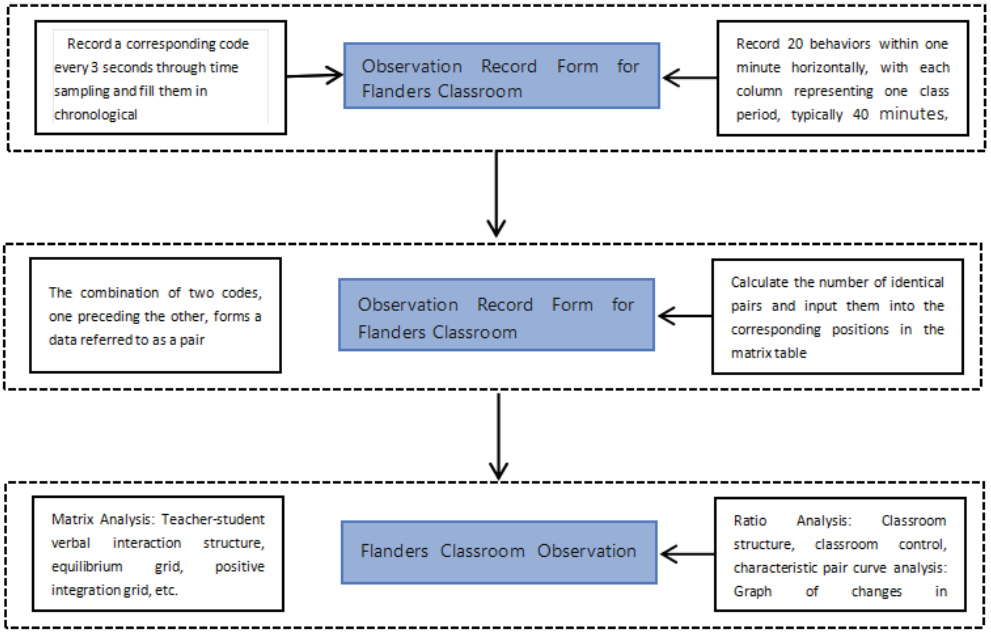


**Figure 1.1 Flanders Interaction Analysis System Analysis Process Diagram**

The Flanders Interaction Analysis System provides a targeted analysis of classroom teaching behavior, overcoming the limitations of traditional classroom observation methods in quantitatively evaluating teaching. It demonstrates significant advantages in scientifically analyzing classroom verbal behavior. However, since its inception by Flanders nearly 60 years ago, this analysis system has undergone significant development. With the widespread application of technology in classrooms, such as multimedia, virtual reality, computer operations, and the continuous deepening of researchers' understanding of teaching behavior cognition, many scholars have become aware of the shortcomings of the observation scales in this interaction analysis system.

Subsequently, researchers have continuously improved the observation scales proposed by Flanders to meet the changing demands of modern classroom teaching in society. For example, Edmondson proposed the Verbal Interaction Coding System (VICS) [3], while Gao Ying and their team improved the Flanders Interaction Analysis System (FIAS) based on the characteristics of the chemistry discipline, forming the 3C-FIAS analysis system. Professor Mu Su from South China Normal University approached the analysis from the perspective of teaching activities [4], proposing the Teaching Behavior Analysis System (TBAS) through the analysis of teaching behavior in an information-based teaching environmen t[5]. These systems, taking into account factors such as research subjects and disciplinary characteristics, have made further improvements to the Flanders Interaction Analysis System.

## 2. Construction of Teaching Behavior Observation Scale

Based on the unique characteristics of mathematics teaching and relevant definitions of teaching behaviors, the author combined the Flemish Interaction Analysis System with other improved classroom observation tools, and after repeated revisions, redesigned the observation indicators for junior high school mathematics classrooms and reconstructed the observation form. This observation form covers three aspects: teacher, student, and teaching interaction. To simplify the coding process, the author adopted the dual coding proposed by Wu Xiaopeng, focusing the observation points on teaching behaviors such as classroom questioning, answering, feedback, and blackboard writing for in-depth analysis[6]. For specific content, please refer to Tables 2.1, 2.2, and 2.3.

**Table 2.1 Teacher Behavior Observation Scale**

| Behavior Subject | Behavior Type | Code1 | Behavior Description | | | Code2 |
|---|---|---|---|---|---|---|
| Teacher | Verbal Behavior | T1 | Lecture | | | T1 |
| | | T2 | Instruction | | | T2 |
| | | T3 | Criticism/Discipline Maintenance | | | T3 |
| | | T4 | Questioning | Questioning Method Straightforward | Straightforward | T4A |
| | | | | | Leading | T4B |
| | | | | | Rhetorical | T4C |
| | | | | | Follow-up | T4D |
| | | | | Question Type Recall | Question Type Recall | T4a |
| | | | | | Understanding | T4b |
| | | | | | Application | T4c |
| | | | | | Analysis | T4d |
| | | | | | Evaluation | T4e |
| | | | | | Synthesis | T4f |
| | | T5 | Feedback | Positive Feedback | Acceptance/Supplementation | T5A |
| | | | | | Guidance | T5B |
| | | | | | Encouragement/Agreement | T5C |
| | | | | Negative Feedback | Disapproval/Criticism | T5a |
| | | | | | Interruption/Proxy Response | T5b |
| | | | | | Ignoring | T5c |
| | Activity Behavior | T6 | Demonstration Presentation/Demonstration | | | T6 |
| | | T7 | Inspection/Patrol | | | T7 |
| | | T8 | Guidance | | | T8 |
| | | T9 | blackboard writing | Blackboard Written Summary | | T9A |
| | | | | Framework | | T9B |
| | | | | Chart | | T9C |
| | | | | No Blackboard | | T9D |

**Table 2.2 Student Behavior Observation Scale**

| Behavior Subject | Behavior Type | Code1 | Behavior Description | | Code2 |
|---|---|---|---|---|---|
| Student | Verbal Behavior | S1 | Response | Group Response | S1A |
| | | | | Individual Voluntary Response | S1B |
| | | | | Individual Passive Response | S1C |
| | | S2 | Activity Interaction | Discussion | S2 |
| | | S3 | | Presentation | S3 |
| | | S4 | | Active Speaking | S4 |
| | Activity Behavior | S5 | Operation | Demonstration /Presentation | S5 |
| | | S6 | | Practice/Drawing | S6 |
| | | S7 | | Thinking | S7 |
| | | S8 | | Waiting for Execution | S8 |

**Table 2.3 Interaction Behavior Observation Scale**

| Interaction Type | Interaction Mode | InteractionBehavior Combination | Code |
|---|---|---|---|
| Teacher-Student Interaction | Q&A | Guided Question - Answer - Feedback... Question - Answer - Feedback (Individual) | D1 |
| Teacher-Group Interaction | Communication-Based | Students solving problems/discussing - Teacher (Individual/Group) Guidance (Clearly guided by the teacher in the group/individual in the group) | D2 |
| Teacher-Class Interaction | Q&A | Guided Question - Answer - Feedback... Question - Answer - Feedback (Entire class) | D3 |

| Interaction Type | Interaction Mode | InteractionBehavior Combination | Code |
|---|---|---|---|
| Cross-Interaction | Multi-directional | Questioning - Task Assignment - Discussion Exchange - Teacher Guidance - Student Presentation - Teacher Evaluation (Teacher guiding groups while also providing guidance to the entire class) | D4 |
| | | Question - Answer - Feedback... Question - Answer - Feedback (Feedback directed from individual to whole class) | |
| Student-Teacher Interaction | Initiative-Based | (Student-initiated) Questioning - (Teacher) Clarification... (Student-initiated) Questioning - (Teacher) Clarification | D5 |
| Student-Student Interaction | Freeform | Students discussing among themselves (often occurs after the teacher assigns tasks for students to discuss) | D6 |

The following text will provide a detailed analysis of the construction process of the teaching behavior observation scale, and elaborate on the thought process and reasons for modifications.

### 2.1 The coverage of observation indicators is not comprehensive enough, and the subjectivity of students is not highlighted

In the Flanders Interaction Analysis System, there are a total of 10 behavioral observation indicators, with 7 focusing on teacher behaviors. However, in actual teaching processes, various behaviors often intertwine, leading to the necessity of determining the main teaching behaviors within a brief 3-second window during coding. This practice often fails to comprehensively reflect all behaviors in teaching. With the increasing emphasis of modern curriculum reforms on the subjectivity of teaching, teaching should pay more attention to the student's subjective position, and teachers should better assume the role of guides, allowing students to play a subjective role in the classroom. Given the inadequacy of existing scales to fully reflect student subjectivity and behavioral comprehensiveness, the author has constructed a new scale, divided into subjective observation and behavioral observation aspects, to increase the observation of student behavior and provide a more detailed analysis of teacher behavior.

### 2.2 Overemphasizing verbal behavior neglects non-verbal behavior

The Flanders Interaction Analysis System falls short in observing nonverbal behavior, although these behaviors cannot be directly expressed through language, they are nonetheless crucial avenues reflecting the authentic responses of teachers and students to classroom teaching. Therefore, in the redesigned scale, the author categorizes the behaviors of teachers and students into two aspects: verbal and nonverbal, in order to more comprehensively capture the essence of classroom interaction.

### 2.3 Focusing on the specific categorization of key teaching behaviors

The complexity of teaching activities in the classroom is self-evident. Referring to the expert arguments presented by Cao Yiming[7], key behaviors in teaching were distilled and classified based on the logic of questioning, answering, feedback, as well as the presentation format of the entire lesson. These four teaching behaviors include questioning, answering, feedback, and board work. Firstly, questioning is one of the core components in the teaching process, with a wide variety of methods and types. Teacher questioning methods can be categorized as direct questioning, posing questions, rhetorical questioning, and probing, among others. Based on the types of questions posed, combined with contemporary learning behaviors in the information age and Bloom's taxonomy, they can be further subdivided into various types including recall, understanding, application, analysis, synthesis, and evaluation types[8].Secondly, students' forms of response are also diverse, including whole-class responses, individual voluntary responses, and individual passive responses, among others. These response methods all play important roles in teaching. Thirdly, teacher feedback behavior involves timely evaluation and guidance of student responses. The author categorizes it into two types: positive feedback and negative feedback. Positive feedback entails affirmation and encouragement of student performance, while negative feedback involves providing guidance and suggestions on behaviors that are detrimental to student learning progress. Lastly, as an essential auxiliary tool in classroom teaching, board work also comes in various forms, including framework-based board work, graphic board work, and no-board work, among others. Choosing the appropriate form of board work based on teaching content and needs can better assist students in understanding and memorizing knowledge.

### 2.4 Redefining interaction, reshaping classroom continuity

The Flanders system is based on linguistic analysis of classroom interaction, but observation scales indicate that the analysis often isolates teacher and student behaviors. This paper leans more towards defining interaction as a series of combined behaviors involving mutual participation between teachers and students, where both parties are present simultaneously, and teaching behaviors occur at least twice. Cao Yiming[9] categorizes interaction into teacher-individual, teacher-group, and teacher-class interactions, while Zheng Changlong [10]summarizes

them as behavior pairs or behavior chains, known as the CPCP model. Combining the perspectives of both scholars, this paper constructs an observation scale for interaction, reanalyzing teacher and student behaviors based on the types and patterns of interaction subjects to gain a comprehensive understanding of classroom dynamics.

## 3. Encoding Reliability Test

In the process of coding in this article, emphasis has always been placed on reliability checks. When conducting qualitative research, there are typically two methods for assessing the reliability of coding. Firstly, observing the temporal stability of coding ensures that significant changes do not occur over time. Secondly, employing a parallel coding method, which examines the consistency among different coders, ensures the reliability of coding outcomes[11].

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