

A Comparative Study on the Quality of Classroom Teacher-Student Interaction between Novice and Expert Teachers of Elementary School Mathematics

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Abstract: Using the Classroom Teacher-Student Interaction Assessment System as a research tool, we observed and recorded the classroom teacher-student interaction between novice teachers and expert teachers, and conducted statistical and data analysis on the quality of teacher-student interaction from the perspectives of overall level of teacher-student interaction, emotional support, classroom organization, and teaching support. The gaps between teachers at different stages of professional development were explored, and finally, suggestions were given in three aspects.

1. Introduction

Teacher-student interaction is the interaction between two subjects, teachers and students, in the classroom context, which in turn causes psychological or behavioral changes in students. The interaction between teachers and students not only has an impact on students' cognitive development, mental health and behavioral performance, but also has great significance for teachers' self-development and improvement of teaching quality. The CLASS classroom interaction assessment system was created by Professor Pianta's team at Virginia State University, and has high reliability and validity after years of experiments. It has been used by scholars in China in the field of preschool education, but it is less used at the primary level.

Therefore, this study will use the Class-room Assessment Scoring System as a research tool to reveal the differences in the quality of student-teacher interaction between novice teachers and expert teachers, and to provide reference for the professional growth of novice teachers.

2. Research Design

2.1. Research Subjects

Table 1 Basic information of study subjects.

	Number	Years of teaching experience	Grade Levels Taught	Course content
Novice teachers	T1	0	Year 4	The Classification of Triangles
	T2	1	Year 5	Representing Numbers with Letters
	T3	2	Year 6	The Surface Area of a Cylinder
expert teachers	T4	12	Year 5	Representing Numbers with Letters
	T5	14	Year 6	The Surface Area of a Cylinder
	T6	18	Year 4	The Classification of Triangles

Based on American scholar Berliner's theory of teacher professional development and its description of teachers in the beginning, progress, competence, competence and expert stages, this

study selected classroom recordings of three outstanding teachers as the sample of expert teachers for analysis. All three teachers were senior elementary school teachers with more than ten years of actual teaching experience and had won many awards in national, provincial, and municipal teaching competitions. At the same time, I selected the classroom transcripts of three teachers with 0-2 years of teaching experience as the analysis sample of novice teachers. This study used the same classroom with the same classroom content for each group of teachers, and the specific information is shown in Table 1.

2.2. Research Methodology

This study uses the Classroom Assessment Scoring System, qualitative classroom observations and comparative analysis. After years of practical research, Professor Pianta's team has published the CLASS classroom interaction assessment system, which has high reliability and validity and has been used in a number of studies around the world, with strong cultural adaptability. The primary 4-6 version of the CLASS Classroom Interaction Assessment System was used for this study, as the target population was mathematics teachers in primary 4-6. It consists of three main domains: emotional support, classroom management, and educational support, and ten secondary indicators, each consisting of 4-5 target behaviours, as shown in Figure 1. The CLASS system uses a seven-point scoring system that divides the rating of each indicator into three levels.

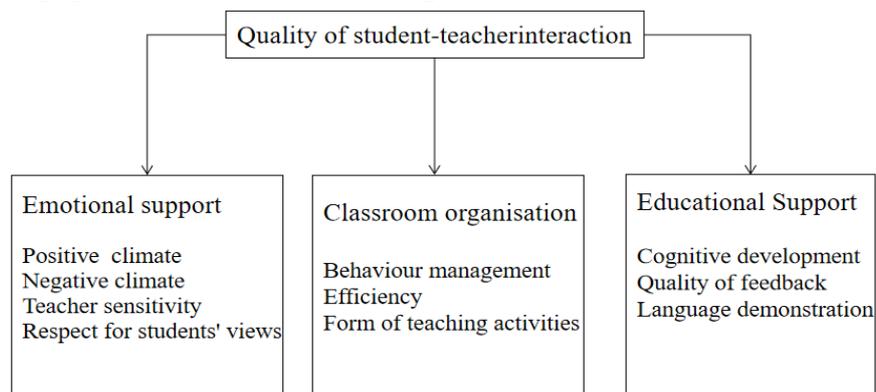


Figure 1 Dimensions and framework of the CLASS system.

3. Research Findings and Analysis

The classroom recordings were observed and analysed to obtain statistics on the scores of novice teachers and expert teachers on each level of the indicators, as shown in the table below.

Table 2 Descriptive statistical analysis of the quality of teacher-student interaction in primary school mathematics classrooms. (N=6)

Variables	Type of teachers	Average	Maximum value	Minimum value	Standard deviation
Emotional support	Novice teachers	4.42	4.56	4.25	0.16
	Expert teachers	6.13	6.19	6.06	0.06
Classroom organisation	Novice teachers	3.53	3.58	3.50	0.05
	Expert teachers	5.80	6.08	5.50	0.29
Educational Support	Novice teachers	3.53	3.75	3.33	0.21
	Expert teachers	5.94	6.17	5.67	0.25

As can be seen from Table 2, the quality of teacher-student interaction was significantly higher overall for expert teachers of primary mathematics than for novice teachers. In terms of overall scores, novice teachers' teacher-student interaction quality was at the lower-middle level and expert teachers' teacher-student interaction quality was at the upper-middle level. In order to make a deeper comparison, this study will analyse the differences in ten subscales under the three major domains of emotional support, class organisation and pedagogical support.

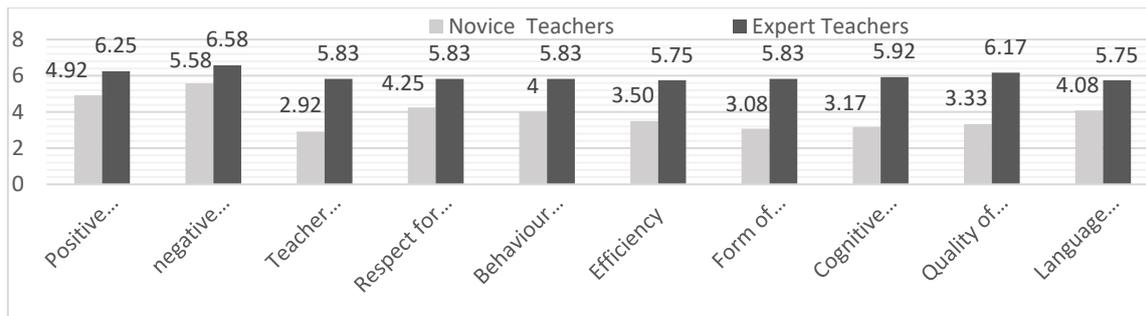


Figure 2 Histogram comparing the mean scores of secondary indicators of teacher-student interaction in classrooms of novice teachers and expert teachers.

As can be seen from Figure 2, of the ten dimensions of the CLASS assessment system, novice primary school teachers differed less from expert teachers on the positive and negative climate dimensions, while they differed significantly from expert teachers on the remaining eight dimensions, with the largest gap on the teacher sensitivity dimension.

3.1. Analysis of Differences in Areas of Emotional Support

3.1.1. Positive and Negative Climate

Positive and negative climate reflect the emotional connection between teachers and students and the teaching climate. The mean scores of novice teachers on the two dimensions of positive and negative climate were 4.92 and 5.58, which were in the middle to upper range, indicating that the classroom climate of novice teachers was basically positive, although there were still differences with the classroom climate of expert teachers, but most novice teachers performed well in terms of teacher-student communication and respect for students. A positive classroom climate was evident not only in the positive conversational interactions between teachers and students, such as teachers saying, "Great, you're so good at learning" and "Child please", but also in the non-verbal communication between teachers and students, such as teachers always smiling and teachers listening with their heads down. No hostile behaviour was observed in the teachers' classrooms.

3.1.2. Teacher Sensitivity

Teacher sensitivity refers to the ability of teachers to perceive students' learning and emotional needs and to respond to them in a timely manner. Novice primary school teachers scored an average of 2.92 on the teacher sensitivity dimension, the lowest score on the secondary scale. This is a low level on the CLASS scale. Expert teachers scored 5.92 on this dimension, which is in the middle to upper range.

Novice teachers have significant deficits in problem awareness and problem solving. Some novice teachers focus only on the academic needs of their students and fail to attend to their students' emotional needs in a timely manner, while others limit their activities to the immediate vicinity of the podium and are only aware of the needs of some students. Also, novice teachers often ignore classroom emergencies and matters unrelated to classroom teaching in order to complete their teaching tasks. Novice teachers usually prioritise the completion of teaching tasks, but the way they handle them may reduce students' interest in learning.

Expert teachers are more sensitive to teaching priorities and are able to detect and respond quickly when students show expressions of confusion. This paper assesses teachers' sensitivity not only by direct observation of their behaviour, but also indirectly from the students' perspective, for example, whether they are comfortable expressing themselves and whether they actively seek help from the teacher.

3.1.3. Respect for Students' Views

Respect for students' perspectives is an examination of whether teachers are truly student-centred and attentive to students' views.

The majority of novice teachers' classrooms are still teacher-centred, expecting the whole lesson

to follow a strict pre-determined flow. Novice primary school teachers fear that by leaving room for students to play, they will not be able to take control of the classroom and therefore use more harsh teaching methods to control classroom instruction. The expert teacher always encourages students to express their views and often asks them 'why', giving them more opportunities to express their views in classroom situations. The teacher asks the students to play the role of the 'little teacher' after the group discussion, encourages the students during the presentation and guarantees their right to speak in the classroom, so that they can actively participate in the classroom teaching.

3.2. Analysis of Differences in Classroom Organisation Areas and the Reasons for Them

3.2.1. Behaviour Management

The behaviour management dimension examines the teacher's ability to provide clear behavioural expectations and to use proven methods to correct students' misbehaviour.

Observational comparisons show that novice teachers are less able to manage problem behaviour and have difficulty stopping problem behaviour in the classroom in a timely manner. Sometimes teachers ignore problem behaviour or use harsh and hard words to criticise students in order to maintain order in the classroom. Novice teachers are generally less able to monitor the classroom as a whole holistically and do not provide clear classroom rules and expectations of student behaviour in the early stages of teaching. Some novice teachers reported that although they agreed with the educational philosophy of teacher-student equality and knew that criticising students in the classroom would affect a good teaching atmosphere, they said that there was no alternative to this, reflecting the novice teachers' inexperience in the classroom and their difficulty in integrating educational theory with the actual classroom.

Expert teachers are able to stop problem behaviour before it starts, while skillfully using eye signals to focus and correct problem behaviour while maintaining the current positive classroom atmosphere. Several expert teachers have established a behavioural routine in the classroom where teachers remind students to listen carefully to what others are saying. Also, there were very few student disruptions in the expert teachers' classrooms, which is an indirect indication of their good behaviour management skills and extensive practical teaching skills.

3.2.2. Efficiency

The efficiency dimension examines whether the teacher makes full use of time in the classroom to organise teaching activities and engage students in learning.

Novice teachers had clear teaching objectives and reasonable teaching arrangements in the classroom, but when students were engaged in collaborative inquiry, most groups were not clearly divided, with some students actively participating and others wandering from the sidelines. When classroom disruptions occur, such as when other teachers come to consult, the novice teacher simply pauses instruction, causing the class to become chaotic and the novice teacher fails to arrange other learning activities to transition the classroom disruptions.

Expert teachers who prepare teaching aids such as paper sheets, animated videos and geometry models in advance of lessons are able to improve teaching efficiency, and when working in small groups, students are able to group together quickly and engage in productive collaborative discussions with high levels of classroom participation. When disruptions are encountered, teachers consciously reduce their impact by giving students tasks to do before addressing them.

3.2.3. Form of Teaching Activities

The teaching activity form dimension is concerned with whether teachers can fully engage students' interest in learning in the classroom and use a variety of activities and materials to motivate students to actively participate in learning.

Most novice teachers organise their teaching activities in a single format, relying mainly on narratives and questions and answers, with less use of summarising and guiding strategies. Students still learn mainly through passive indoctrination by watching and listening to the materials presented by the teacher, lacking hands-on activities and opportunities for practice, making the

teaching atmosphere slightly monotonous and dull.

Expert teachers are more diverse and can provide a variety of teaching materials, such as children's songs, animations and graphic cards, to maintain students' interest in learning. At the same time, the expert teacher's questioning and guided statements can accurately clarify the lesson's knowledge and learning objectives, and the teaching is tightly arranged.

3.3. Analysis of Teaching Support Areas and Reasons

3.3.1. Cognitive Development

The cognitive development dimension assesses whether teachers promote students' thinking development through teacher-student interaction in the classroom.

Novice teachers' questions are dominated by closed questions. Some teachers consciously asked open-ended questions to their students, but did not allow enough time for students to think about the questions in order to complete the classroom task, which did not promote the development of students' deeper cognitive skills. In novice teachers' classrooms, The teacher's questions are often a means of conducting teacher-student interaction, lacking in thoughtful and inspiring exploration and design of the questions, and rarely summarising the students' responses, or analysing and discussing them based on their classmates' answers and summarising the easy points of error.

Expert teachers often ask students 'what are the differences between these methods' and 'how did you come up with them', spiral through questions and answers to expand students' thinking, organise reasoning and judgements, discuss and analyse, and prompt students to externalise their internal thinking through language activities. The process is externalised through language activities. The questions are designed in such a way that they are not confined to pre-determined solutions, but are also appropriate for follow-up questions and summaries, giving full play to the role of teacher-student interaction in guiding students' thinking and developing their skills.

3.3.2. Quality of Feedback

The quality of feedback dimension assesses the level of teacher feedback, which extends students' knowledge and understanding and promotes sustained engagement. Most novice teachers took some steps to encourage students to participate in the classroom, but the interaction with students was rather one-dimensional, making it difficult to form multiple feedbacks on the same question. When a student answered incorrectly, the teacher usually dismissed the answer and moved on to ask other students for the correct answer. Expert teachers praised students and continued to ask questions based on their answers, guiding them to think more deeply and encouraging them.

3.2.3. Language Demonstration

The language modelling dimension is concerned with the quality and quantity of instructive language used by teachers. Novice teachers lack the communication and interaction of open-ended questions, fail to clearly understand students' cognitive levels, and are unable to explain new and complex concepts using vocabulary that is familiar to students and appropriate to their level of thinking development, making it difficult for students to understand. Novice teachers focus on the role of language in teaching and learning and are able to restate students' ideas frequently, but extend them relatively infrequently. Expert teachers are more aware of students' developmental levels of thinking and will actively seek out easy-to-understand words to explain new concepts to students, and frequently summarise and expand on students' responses to make them more organised in their teaching.

4. Conclusions and Recommendations

Significant differences existed between novice teachers and expert teachers in terms of the quality of teacher-student interactions in the classroom. The following suggestions are made to novice primary school mathematics teachers.

4.1. Changing the Concept of Teaching to Achieve Equal Dialogue between Teachers and Students

The initiator of teacher-student interactive behaviour is mostly the teacher subject, and students are not good at initiating interactive behaviour. There are also novice teachers who ignore the developmental needs of their students in order to implement a predetermined teaching plan, which is a result of misconceptions about teaching and learning. The purpose of interaction is to enable students to become independent and creative thinkers, capable of analysing and solving problems, and never to emphasise the acquisition of subject knowledge in the form of simple 'questions and answers' between teachers and students. Teachers must first change their traditional teaching philosophy and not appear in front of students as an authority or oppressor, as both teachers and students are completely independent individuals, and if either party only emphasises their own 'subject position' and suppresses and restrains the autonomy of the other, it will affect the effectiveness of teacher-student interaction.

Teachers should develop a sense of respect and trust for students, regard them as developing, independent and unique people, give full play to creative educational resourcefulness and leave the right to create life in the classroom to students. On this basis, a harmonious classroom environment is built, a democratic and equal teacher-student relationship is constructed, and a true equal dialogue between teachers and students is achieved. Classroom teaching is a dynamic generation of creative activities, teachers should focus on being human-centred and encourage students to ask questions, allowing them to break free of constraints and take the initiative to think, question and argue about an unfamiliar body of knowledge.

4.2. Strengthen Teaching Reflection and Research to Enhance Professionalism

Most teachers' reflections on teaching focus on reflections on classroom teaching sessions, while reflections on teacher-student interactions are less frequent. Therefore, teachers should first establish a sense of reflection on the interactive behaviour of classroom teaching. By reflecting on the interactive behaviour, teachers summarise the high-quality behaviour of teacher-student interaction and correct the shortcomings in practice to improve the quality of teacher-student interaction. At the same time, when teachers reflect on the problems in teacher-student interaction, they should not only teach mechanically under the guidance of educational theories, but should also 'reflect in action', which requires teachers to have a keen awareness of problems, to conduct research on problems that arise in teaching practice, and to apply research results to practice, as researchers, using specific research methods to try to solve problems in teaching contexts.

4.3. Enhance Observational Learning and Skills Training

Teachers' own attitudes to interaction and educational quality are important factors in the quality of classroom interaction, for example, novice teachers' low scores in the areas of 'cognitive development' and 'language modelling' indicate that teachers have not accumulated enough language and are not familiar with students' learning. Some of the novice teachers did not yet have a full grasp of the subject matter and educational psychology. Some novice teachers have some concepts of teacher-student interaction, but lack professional training in teacher-student interaction skills.

In practice, teachers should pay attention to observing and studying quality lesson examples, and at the same time pay attention to strengthening communication with expert teachers, reflecting and summarising in a timely manner, learning to find the theoretical basis behind the interaction strategies of excellent teachers, and then in turn further guiding their own teaching practice, in the teaching environment through repeated practice and simulation to achieve proficiency in the teaching environment, using theory to guide practice, enhance sensitivity in education and improve teaching standards.

Novice primary school teachers need targeted training in interaction skills based on reflection. Novice teachers' level of interaction using non-verbal behaviour was low. Teachers need to consciously train facial expressions and body language, not to treat feedback as a general

conversation, but to ask "why" or "how" in response to students' feedback. "They also need to be aware of the relevance of interactive language to the development of students' thinking, and to use language that students can understand to achieve truly interactive teaching.

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