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Investigation and Countermeasure Research on Learning Difficulties in Mathematics Transition from Junior High to Senior High School

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Abstract: The transition stage of mathematics learning from junior high school to senior high school is critical for developing students' mathematical competence and often witnesses notable academic polarization. Based on a questionnaire survey of 476 valid responses (effective rate 95.2%) from Grade 10 students, this empirical study examines current transitional difficulties. The results indicate that 78.3% of students perceive marked knowledge disconnection, 55.4% struggle with heightened abstraction and reasoning demands, 46.2% rely on mechanical problem-solving strategies, and 43.7% experience significant learning anxiety. In response, this paper proposes targeted countermeasures from four perspectives: collaborative teaching research between junior and senior high school teachers, optimization of classroom teaching models, guidance on scientific learning methods, and enhancement of psychological intervention. These findings aim to inform improvements in senior high school mathematics instruction and support the cultivation of students' core mathematical literacy.

Keywords: Junior and Senior High School Transition; Mathematics Learning; Questionnaire Survey; Thinking Barriers; Teaching Countermeasures.

1. Introduction

As a core discipline in basic education, mathematics features strong logic, abstraction and systematicness. With the continuous advancement of the new curriculum reform, there exists an obvious gap between junior and senior high school mathematics in terms of curriculum objectives, knowledge depth and competency requirements. For a long time, numerous students who achieved excellent mathematics grades in junior high school experience sharp grade decline, loss of learning interest and weakened self-confidence after entering senior high school, a phenomenon commonly known as “senior one mathematics learning regression”. Helping students smoothly bridge the mathematics learning gap between junior and senior high school has become an urgent issue in senior high school mathematics education [1]. Based on empirical investigation, this study accurately identifies the major difficulties of fresh senior high school students during the transitional period. From four core dimensions including knowledge system, thinking ability, learning habits and psychological state, this paper puts forward systematic countermeasures based on questionnaire data analysis [2].

2. Research Design and Data Sources

2.1. Research Framework and Dimension Division

This research constructs a four-dimensional analytical framework covering knowledge connection, thinking transformation, learning habit adaptation, and psychological adaptation to comprehensively explore students’ transitional difficulties in mathematics learning [3].

2.2. Research Subjects and Samples

The sample comprised Grade 10 students recruited from two public senior high schools in a prefecture-level city in eastern China—one serving as a district-level key school and the other as a general comprehensive school. A total of 500 questionnaires were distributed, with 476 valid cases returned, yielding an effective response rate of 95.2%. Among the valid respondents, 52.3% were male and 47.7% female. Regarding junior high school mathematics performance (on a 120-point scale), 31.5% scored at or above 100 points (excellent), 26.1% between 89 and 99 (good), 24.8% between 72 and 88 (medium), and 17.6% below 72 (weak). Schools and classes were selected through convenience sampling, while students within each class were surveyed in full to ensure broad coverage across prior achievement levels. Compared with the overall distribution of incoming Grade 10 students in the region, the sample shows no significant deviation in gender or academic background, supporting its general representativeness for ordinary public senior high settings [4].

2.3. Questionnaire Design and Data Processing

A self-designed Questionnaire on Learning Difficulties in Junior-Senior High School Mathematics Transition was adopted for data collection [5]. Compiled based on existing literature and practical teaching experience, the questionnaire includes basic personal information and three core modules: mastery and connection of mathematical knowledge, transformation of mathematical thinking and methods, and adaptation of learning psychology and habits.

Excel and SPSS were used for statistical analysis. Frequency analysis and percentage statistics were mainly applied to demonstrate the overall characteristics and specific manifestations of students’ transitional difficulties.

3. Research Results and Data Analysis

Statistical analysis of valid questionnaires reveals comprehensive difficulties in mathematics transition, with detailed data and analysis presented as follows.

3.1. Obvious Disconnection in Knowledge System

When assessing the bridging utility of junior high mathematics content, merely 12.3% of students regarded it as highly cohesive and supportive. By contrast, 48.5% identified moderate utility with conspicuous gaps, 29.8% found it scarcely usable, and 9.4% deemed it completely unhelpful. In aggregate, over three-quarters of the sample (78.3%) reported obvious knowledge disconnection between the two stages.

For instance, senior high school mathematics puts forward extremely high requirements for the maximum and minimum values of quadratic functions and interval root distribution, while junior high school teaching only focuses on basic graphical cognition [6]. Besides, knowledge points such as cross multiplication and advanced factorization, which are weakened in junior high school curriculum, serve as essential tools for senior high school analytic geometry.

3.2. Lagged Thinking Transformation and Insufficient Abstract Competence

Regarding the most prominent shift in senior high mathematics thinking, 55.4% of students identified heightened abstraction along with greater demands for spatial imagination and logical reasoning; 22.1% attributed the main challenge to prolonged problem-solving procedures and heavier computational loads; 12.5% perceived only trivial differences from junior high; and the remaining 10.0% expressed vague discomfort without pinpointing specific causes. In combination, over three-quarters of the respondents acknowledged substantial changes in cognitive demands [7].

The data indicates that most students are aware of the upgraded thinking requirements but fail to adapt their cognitive ability accordingly. Junior high mathematics mainly focuses on specific and intuitive constant operations, while senior high mathematics introduces highly abstract symbolic systems from the very beginning, such as sets and formal function definitions. This abrupt improvement in abstraction constitutes the core reason for students' learning obstacles.

3.3. Solidified Learning Methods and Insufficient Autonomous Learning Ability

In terms of problem-solving strategies facing intensive exercises, only 21.7% of students develop independent thinking and multi-angle analysis habits; 46.2% rely mechanically on teacher-taught question types and formula application; 32.1% tend to refer to answers directly without independent thinking.

It is evident that most students retain the passive learning mode of mechanical memorization, rote practicing and imitative problem-solving formed in junior high school. Given the high flexibility of senior high mathematics problems, mechanical training is no longer effective. The lack of preview, review and reflective summary habits severely restricts academic improvement.

3.4. Severe Psychological Gap and Learning Anxiety

In terms of overall emotional responses to senior high mathematics, only 18.4% of students maintained confidence and embraced the subject as a positive challenge; 43.7% reported intense pressure accompanied by fear of mathematics classes; 28.9% experienced notable frustration and waning self-esteem; and the remaining 9.0% adopted an indifferent and passive attitude. In total, more than four-fifths of the respondents exhibited negative emotional states during the transitional period.

Combined with the background that 31.5% of the samples were top students in junior high school, it can be concluded that many high-achieving students suffer from tremendous psychological setbacks after unsatisfactory initial examinations [8], resulting in learned helplessness, which further leads to passive learning attitudes.

3.5. Limited Effectiveness of Transition Training Courses

Although 58.4% of students participated in transition training courses (either fully or partially), more than 60% of them still suffered severe learning difficulties in formal senior high study. It indicates that most commercial transition courses merely conduct advanced knowledge teaching without effective cultivation of mathematical thinking and learning habits. Short-term knowledge cramming may even exhaust students' learning enthusiasm and violate educational laws [9].

4. Cause Analysis of Mathematics Transition Difficulties

4.1. Differences in Curriculum Standards and Textbook Compilation

Compulsory mathematics curriculum standards emphasize popularity, fundamentality and developmental nature with reduced requirements for operation difficulty and logical reasoning. In contrast, senior high school curriculum standards highlight selectivity [10], abstraction and advanced development with larger knowledge capacity and higher difficulty. Junior high textbooks introduce knowledge through daily intuitive examples, while senior high textbooks prioritize rigorous mathematical deduction and theoretical reasoning, forming an objective learning gap.

4.2. Mismatched Teaching Methods and Rhythm

Junior high school teachers have sufficient class time for repeated explanation, blackboard demonstration and intensive exercises due to relatively simple knowledge content. By contrast, senior high school teachers face tight teaching schedules and adopt high-density, fast-paced teaching modes that focus on method guidance rather than repeated consolidation [11]. Students who fail to adapt to the accelerated rhythm will easily encounter learning difficulties.

4.3. Limitations of Students' Cognitive Development

According to Piaget's cognitive development theory, Grade 10 students are in the late transition stage from concrete operational stage to formal operational stage. Some students have not fully developed abstract logical thinking. Faced with complex algebraic transformation and dynamic spatial imagination in senior high mathematics, their limited working memory and cognitive processing speed lead to superficial understanding of mathematical principles.

5. Countermeasures to Break Through Mathematics Transition Difficulties

Smooth mathematics transition requires systematic educational optimization rather than fragmented transitional lessons at the beginning of senior high school.

5.1. Strengthen Collaborative Teaching Research Between Junior and Senior High Schools

Senior high school teachers should actively clarify the boundaries and weakened contents of junior high mathematics curriculum [12]. Teaching research groups can organize curriculum comparison seminars to sort out key transitional knowledge including absolute value, quadratic radicals, advanced factorization and cross multiplication. Targeted transitional micro-lessons within the first two to three weeks of senior high school can effectively fill knowledge gaps and build learning scaffolding for students.

5.2. Optimize Classroom Teaching and Alleviate Thinking Transition Pressure

First, adopt visualized teaching. Information technology tools such as Geometer's Sketchpad and GeoGebra can transform abstract symbolic concepts into intuitive graphs to reduce cognitive load when teaching sets, mappings and functions.

Second, slow down the initial teaching rhythm. Teachers should avoid blind progress pursuit in the first semester, increase classroom interaction and deductive demonstration to expose students to complete thinking processes.

Third, infiltrate mathematical thinking systematically. On the basis of junior high school thinking methods such as number-shape combination and classified discussion, senior high teaching should strengthen the application of advanced mathematical thinking and guide students' transformation from arithmetic thinking to algebraic thinking.

5.3. Strengthen Learning Method Guidance and Rebuild Learning Habits

Teachers should systematically instruct students on scientific mathematics learning strategies. Standardize homework requirements to encourage analytical thinking rather than mechanical formula application. Guide students to establish error logs and excellent problem notebooks, focusing on error cause analysis, thinking reflection and multiple problem-solving methods. Arranged targeted preview guidelines and in-class quizzes can effectively promote students' preview and review habits.

5.4. Implement Psychological Intervention to Relieve Learning Anxiety

Schools and teachers should carry out reasonable expectation management, informing students that unsatisfactory initial examination results are normal to reduce psychological burden on former top students [13]. Teachers should control examination difficulty appropriately in the first semester, adhering to the principle of low starting point, gradual progress and layered promotion to help students accumulate successful learning experience and rebuild self-confidence. Individual psychological counseling and academic tutoring should be provided for students with severe learning burnout and anxiety.

6. Conclusion

The junior-senior high school mathematics transition is a complex adaptive process involving knowledge system upgrading, thinking mode transformation, learning habit reconstruction and psychological adjustment. Empirical data fully proves that students face comprehensive multi-dimensional difficulties during this period. Educators should adhere to the concept of progressive education. Through knowledge gap compensation, gradual thinking transition guidance, scientific learning method cultivation and systematic psychological support, schools can help students smoothly pass the critical transitional stage. Only by thoroughly optimizing the coherent teaching system can solid foundations be laid for students' subsequent science learning and long-term academic development.

References

[1] Ministry of Education of the People's Republic of China. (2022). Compulsory education mathematics curriculum standards (2022 edition). Beijing Normal University Press. (in Chinese)

[2] Ministry of Education of the People's Republic of China. (2020). General high school mathematics curriculum standards (2017 edition, revised 2020). People's Education Press. (in Chinese)

[3] Zhang, J. Y. (2018). Reflections and practices on implementing core literacy in senior high school mathematics textbooks. Curriculum, Teaching Material and Method, 38(1), 56–61. (in Chinese)

[4] Li, S. Y. (2015). Problems and countermeasures of mathematics transition between junior and senior high school. Journal of Mathematics Education, 24(2), 33–37. (in Chinese)

[5] Wang, G. M. (2019). Psychological characteristics and educational countermeasures of students with mathematics learning difficulties. Teaching Reference of Middle School Mathematics, (8), 12–15. (in Chinese)

[6] Jansen, A., Herbel-Eisenmann, B., & Smith, J. P. (2022). Detecting students' experiences of discontinuities between middle school and high school mathematics programs: Learning during boundary crossing. Mathematical Thinking and Learning, 14(4), 285–309.

[7] Gunzenhauser, C., Enke, S. E., Johann, V. E., et al. (2021). Parental and teacher support and elementary students' academic skills during the COVID-19 pandemic. AERA Open.

[8] Bakker, M., Torbeyns, J., Verschaffel, L., et al. (2023). Longitudinal patterns of individual differences in early numerical abilities and their cognitive and environmental correlates. Developmental Psychology.

[9] Kaur, T., McLoughlin, E., & Grimes, P. (2022). Mathematics and science across the transition from primary to secondary school: A systematic literature review. International Journal of STEM Education, 9(1).

[10] Namkung, J., Peng, P., Koziol, N., et al. (2026). Cognitive and foundational predictors of prealgebra competence among students with versus without mathematics learning difficulties. Journal of Educational Psychology.

[11] (Anonymous). (2023). Age and gender differences in mathematics learning during school transition. International Journal of School & Educational Psychology, 11(1), 20–33.

[12] Linnavalli, T., Jylänki, P., Kainulainen, J., et al. (2025). Early mathematical skills and their cognitive predictors: Working memory, spatial and language skills. Scandinavian Journal of Educational Research.

[13] Chinofunga, M. D., Chigeza, P., & Taylor, S. (2022). A framework for content sequencing from junior to senior mathematics curriculum. Eurasia Journal of Mathematics, Science and Technology Education, 18(4), em2092.

Appendix: Questionnaire on Learning Difficulties in Junior-Senior High School Mathematics Transition

Dear students,

This questionnaire aims to investigate your learning status and difficulties during the mathematics transition period from junior high to senior high school. All data is anonymous and only used for academic research, without any negative impact on you. Please answer according to your real learning situation. Thank you for your cooperation.

Part 1 Basic Information

1. Gender

A. Male B. Female

2. Semester

A. First semester of Grade 10 B. Second semester of Grade 10

3. Your mathematics academic level in junior high school (full score 120)

A. Excellent (≥100) B. Good (89–99) C. Medium (72–88) D. Weak (<72)

4. Participation in mathematics transition courses

A. Full participation B. Partial participation C. Never participated

Part 2 Knowledge Connection

5. How would you evaluate the supportive effect of junior high mathematics knowledge on senior high learning?

A. Highly supportive with close connection

B. Moderately supportive with partial disconnection

C. Slightly supportive with most knowledge unusable

D. Almost no support

Part 3 Thinking and Method Adaptation

6. What is the biggest change in senior high mathematics thinking compared with junior high school?

A. Higher abstraction requiring spatial imagination and logical reasoning

B. More problem-solving steps and larger calculation volume

C. Only more knowledge points with minor thinking differences

D. Unclear, only feeling more difficult

7. What is your main problem-solving strategy facing intensive mathematics exercises?

A. Independent thinking and multi-angle analysis before consulting others

B. Relying on teacher-taught question types and formula application

C. Referring to answers directly with little independent thinking

D. Giving up and waiting for teachers' explanation

Part 4 Psychological Adaptation

8. What is your general feeling about senior high mathematics learning?

A. Confident and willing to face challenges

B. Stressed and afraid of mathematics classes

C. Frustrated with reduced self-confidence

D. Indifferent and passive