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Error Reflection and Incentive Guidance: Practical Path of Junior High School Mathematics Long-Term Homework Evaluation from the Perspective of Growth Mindset

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Abstract

Aiming at the phenomenon of emphasizing results over processes in traditional homework evaluation, this study constructs a long-term homework evaluation feedback mechanism for junior high school mathematics from the perspective of growth mindset and explores its practical effects. By using tools such as mindset scales and interview outlines, the study implements practical evaluations through the feedback strategy of ‘error reflection guidance + diagnostic evaluation + motivational evaluation.’ The results show that the depth of students’ homework reflection has improved, their error attribution has gradually shifted to “effort or strategy attribution” and has become dominant, and the specificity and operability of their strategy adjustment have increased. Students generally recognize the teachers’ evaluation methods, and their initiative in facing mathematical learning and challenges has improved. The long-term mathematical homework evaluation and the feedback mechanism proposed in this study can help cultivate students’ growth mindset and foster their core mathematical literacy, providing a practical reference for the reform of junior high school mathematics homework evaluation.

Keywords: Growth Mindset; Junior High School Mathematics; Long-term Mathematics Homework; Evaluation and Feedback; Error Reflection

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1. Introduction

In January 2025, the Central Committee of the Communist Party of China and the State Council issued *The Education Power Construction Planning Outline (2024–2035)* (hereinafter referred to as the ‘Outline’), which explicitly states the need to “comprehensively coordinate the implementation of the ‘Double Reduction’ policy and the improvement of teaching and educational quality.” (Central Committee of the Communist Party of China & State Council, 2025) The ‘Double Reduction’ policy not only provides clear guidance on the functions of homework in terms of ‘improving quality while reducing burden’ but also imposes requirements on how teachers should evaluate and provide feedback on homework. Furthermore, the Outline emphasizes the need to deepen educational evaluation reform, establish a scientific orientation for educational evaluation, and prevent and correct

deviations such as ‘score-first.’ Therefore, to advance the ‘Double Reduction’ policy, enhance educational quality, and deepen evaluation reform, it is essential to prioritize homework evaluation as a vital link.

The Compulsory Education Mathematics Curriculum Standards (2022 Edition) also stipulates that teachers should comprehensively assess and evaluate the formation and development of students’ core literacy through homework; the presentation of evaluation results should focus more on students’ progress, as well as their existing academic level and potential for improvement (Ministry of Education of the People's Republic of China, 2022). The long-term homework serves as a bridge linking two semesters, performing multiple functions such as reviewing old knowledge to gain new insights and providing evaluation and feedback. However, currently, the long-term homework still exhibits certain drawbacks, such as excessive workload, lack of practical effectiveness, and an overly simplistic and extensive nature (Xie, 2022). When evaluating long holiday homework, teachers often face issues such as disconnected or delayed feedback and superficiality. Specifically in mathematics, when focusing on homework evaluation, it is even more necessary to highlight process-oriented assessment, emphasizing students’ progress and efforts in homework, their cognitive attitude towards errors, and adjustments to problem-solving strategies. Based on this, focusing on the impact of long-term homework evaluation on students and exploring how to cultivate students’ growth mindset through it holds significant practical importance.

Practical measures for mathematics teaching focused on growth mindset include providing students with clear feedback and assessment results, evaluating their efforts and exploratory processes, and providing feedback on multiple dimensions of mathematics (Sun, 2018). Additionally, educators should value mathematical errors and guide students to recognize the positive role of mistakes and failures in learning (Kazemi & Stipek, 2001).

In summary, the existing problems in the evaluation of long-term mathematics assignments during extended periods, to some extent, constrain the development of students’ positive mindset when facing academic challenges. As a crucial foundation for helping students confront mistakes and continue to progress, the cultivation of growth mindset is inseparable from the process-oriented approach and feedback optimization in long holiday mathematics homework evaluation. Based on this, this study constructs more targeted evaluation strategies and feedback mechanisms from the perspective of growth mindset, further promoting the development of students’ mathematical core literacy and cultivating their growth mindset. More specifically, this study focuses on the following three questions:

1. How to design an evaluation and feedback mechanism for long-term mathematics homework oriented towards a growth mindset?
2. How does the evaluation of long-term mathematics homework oriented towards a growth mindset influence students’ approach to error handling?
3. What impact do the aforementioned evaluation and feedback mechanisms for long-term mathematics homework have on students?

2. Literature Review

2.1 Growth Mindset and Mathematics Learning

The theory of growth mindset, proposed by American professor Carol Dweck in 2006, posits that students with a growth mindset believe that intelligence or ability can be developed, enabling them to face failures and challenges in learning more positively, whereas students with a fixed mindset tend to believe that their abilities or intelligence cannot be changed, making it more difficult for them to resist setbacks or difficulties encountered in learning (Dweck, 2006). Students with a growth mindset are more willing to see mistakes as opportunities to improve themselves and make progress. They will not deny themselves easily, but look for problems in the process (Andersen, 2001).

There is an interaction between students' mindset, learning motivation, and their self-efficacy, and there is a positive correlation between growth mindset and students' academic performance in mathematics (Su, 2021). Students with a growth mindset orientation tend to experience greater achievement and satisfaction in mathematics learning, whereas those with a fixed mindset orientation often exhibit poorer mathematical performance development (Dong, 2023). Cultivating students' growth mindset is conducive to developing students' academic performance (Wang & Liu, 2023) and cultivating their positive psychological state (Huang, Shang, & Zhang, 2023). Students with a growth mindset are less likely to suffer from academic anxiety and study burnout during learning (Gan, 2024; Wang & Xu, 2022), have a more positive attitude and greater investment in learning when facing difficulties (Diao, Zhou, & Huang, 2020), and have a higher sense of self-efficacy and life satisfaction. Yeager et al. found that growth mindset interventions can significantly improve students' mathematics learning motivation. Especially when students face mathematics difficulties, students will be more willing to persist and try new strategies (Yeager et al., 2019).

2.2 Growth Mindset and Instructional Assessment

Even brief interventions in students' mindset can have lasting effects on student motivation and achievement motivation, and teacher behavior plays a vital role in supporting such classroom interventions (Schmidt, Shumow, & Kackar-Cam, 2015). Research indicates that praising students solely for their intelligence undermines intrinsic motivation, whereas emphasizing effort and process fosters a growth mindset (Mueller & Dweck, 1998). As Black and Wiliam (1998) emphasized, effective formative assessment requires teachers to help students understand the gap between their current performance and learning goals, while providing specific feedback and improvement plans to support meaningful progress. If students can get comments from homework feedback, they will be able to show greater interest in learning. If they can only get graded feedback, their learning performance and learning interest will not change significantly (Butler, 2011). If teachers want to convey a growth mindset, they need to focus on providing students with the feedback they need to evaluate learning; teachers should provide all students with opportunities to be exposed to complex mathematical tasks. Well-designed tasks, if accompanied by clear feedback information, can provide students with a path to a growth mindset, helping them know that they can learn to a higher level, and more importantly, know through evaluation how to reach a higher level (Boaler, 2016).

2.3 Growth Mindset and Error Management

Error reflection plays an indispensable positive role in mathematics learning. Error reflection learning resources can significantly impact students' mathematical learning outcomes. Through error-reflective learning, students can improve their mathematics test scores and enhance their understanding and expression of mathematical concepts (Aquino & Ching, 2022). When teachers require students to reflect on their own mathematical errors, including the types of errors, potential causes of errors, and further improvement steps, errors can exert a positive effect (Santagata, 2005). As Boaler (2016) emphasizes, errors are not failures but essential components of brain development: 'Only when students make mistakes do they engage in deep thinking, and their brains grow.' Sun proposed the teaching practice framework of growth mindset and pointed out that teachers should conduct in-depth exploration of students' mistakes and adhere to guidance when students make mistakes (Sun, 2018). Boaler et al. explored how to foster students' growth mindset through the handling of errors in the classroom, and they found that when teachers encourage students to share their errors and collectively discuss solutions, it can significantly

enhance students' mathematical understanding and confidence (Jo, Dieckmann, Pérez-Núñez, Liu, & W., 2018).

In addition, some scholars in China have also proposed using 'Mathematics Reflection Journals' to enhance students' mathematical reflection abilities (Jing, 2025); teachers should utilize error resources to guide students in summarizing the reasons for errors, thereby changing teachers' and students' attitudes toward errors (Sheng, 2024). When teachers 'reconstruct' students' errors, they should follow the principle of autonomy, providing students who made mistakes with opportunities for self-reflection and guiding them to discover their errors (Ma, 2020).

Most of the existing research focuses more on how teaching strategies in mathematics classrooms affect students' growth mindset. In terms of student evaluation, they also focus on real-time evaluation in the classroom and lack the design of an evaluation feedback mechanism for mathematics homework. Regarding mathematics errors, most of the existing research provides guidance on teachers' error-handling behavior from the perspective of growth mindset. However, there is still a gap in research that combines students' independent error reflection with teachers' evaluation strategies. Under the guidance of growth mindset, this study designed a mathematics homework error reflection form, combined with teacher evaluation, to construct a long-term mathematics homework evaluation feedback mechanism, forming a closed loop from error discovery to evaluation and diagnosis to reflection and improvement, and further filled the practical gap of long-term mathematics homework evaluation in cultivating students' growth mindset.

3. Methodology and Procedures

This study selected 32 students from one 8th-grade class of a middle school in Cangzhou, China, as research participants. These students were asked to complete an error reflection task as part of their long-term mathematics homework assignments. Of the 32 participants, 17 submitted complete error reflection responses and were included in the analysis.

This study adopted a single group of students and employed a pre-test design to measure their mindset levels. After teachers implemented the intervention for the students, interviews were used as a post-test design to explore the impact of the intervention on students. Additionally, a detailed analysis was conducted on the mindset changes of typical students across different stages. Despite its advantage in capturing individual developmental trajectories (Barankin, 2015), this design lacks a control group, which limits the ability to establish causal relationships between the intervention and the observed changes. The absence of a control group prevents ruling out alternative explanations for the improvements in growth mindset and mathematics learning.

3.1 Research Tools

3.1.1 Growth Mindset Scale

To investigate students' mindset orientation, the Growth Mindset Questionnaire was selected for administration. This questionnaire was adapted from the growth mindset scale measuring tools (Chen, Ding, & Liu, 2021; Dweck, 2017). It consists of 24 multiple-choice questions, designed to understand students' thinking patterns, covering content such as students' perceptions of failure, views on challenges, and attitudes toward effort. The questionnaire employs a 5-point Likert scale, with options ranging from 'Strongly Agree' to 'Strongly Disagree.' A higher score at the end of the questionnaire indicates a thinking pattern closer to a growth mindset.

3.1.2 Student Interview Outline

To explore the impact of the growth mindset-oriented junior high school mathematics long-term homework evaluation feedback mechanism implemented in the study on students'

error handling, as well as to further understand the influence of the long-term homework evaluation feedback strategies adopted by teachers on students’ thinking patterns, a student interview outline was designed. This outline facilitates interviews with students after the completion of four homework evaluations.

3.1.3 Error Reflection Section for Homework

The design of the reflection section reshapes students’ cognition of errors through structured questioning. If students view errors encountered in mathematics learning as ‘learning signals,’ they can significantly improve their persistence in mathematics learning. Combining the error reflection handling methods mentioned in the literature and after consultation with frontline teachers, this study designed the following reflection section.

Error Reflection	
Question	Answer
1. Where does the error occur? Where is it stuck?	
2. Why does this error occur? Why here?	
3. Correct solution? Can other strategies be used?	
4. How should we adjust if similar problems occur next time?	

Through the homework reflection section, students engage in a series of self-directed inquiry learning activities aimed at identifying errors, analyzing their causes, and learning from them. Even if some students are unable to fully ‘resolve’ mathematical errors through these autonomous activities, this reflection process enables them to develop a clearer and more comprehensive understanding of their mathematical homework mistakes compared to their initial state.

3.1.4 Growth Mindset-Oriented Evaluation and Feedback Strategies for Long-Term Mathematics Homework

The evaluation of mathematics homework from the perspective of growth mindset focuses on how students view errors and failures in mathematics homework; the homework evaluation given by teachers should be diagnostic and guide the direction of homework improvement; the appropriate use of evaluation language should be emphasized to encourage students to actively face challenges. The evaluation strategies for mathematics summer long homework involved in the study mainly include the following two aspects.

(1) Strengthen the diagnostic nature of the evaluation and guide errors in the direction of improvement

To build an effective long-term homework system grounded in a growth mindset, it is essential to move beyond traditional scoring methods that rely solely on correctness. Instead, homework evaluation should emphasize diagnostic feedback, shifting the focus from merely assessing outcomes to analyzing students’ problem-solving processes and cognitive reasoning. In the evaluation, teachers should clarify the errors in students’ homework and also briefly state the thinking deviations and knowledge connections caused by students’ errors. The evaluation content should include recognition of students’ outstanding performance and unique ideas, as well as analysis of their knowledge weaknesses, and promote the shift of evaluation from result-oriented to process guidance.

In response to the errors that occur in students’ homework, teachers should guide and analyze their special value, guide students to pay attention to knowledge gaps, independently explore and analyze the causes of errors, try other strategies, etc., so as to reconstruct the correct answer ideas. In this evaluation process, the focus is not on the error

itself but on the potential learning value behind the error, providing students with a guidance framework from error identification to thinking correction.

The important value of this evaluation strategy is that it can provide students with clearer feedback on mathematics learning. Students can clearly understand their own strengths, understand the importance of mistakes, accurately target knowledge weaknesses, and master actionable improvement plans. At the same time, it can effectively promote the learning closed loop of 'evaluation-cognition-correction' and further cultivate students' growth mindset.

(2) Appropriate Use of Evaluative Language to Encourage Students to Face Challenges Positively

The appropriate use of evaluative language can guide students to adopt a productive learning attitudes and enhance their interest in mathematics learning. Practical research has found that some students are perfunctory in their homework performance, especially when faced with lengthy questions, they show avoidance behavior and leave blank answer areas. At this time, teachers should use growth-oriented feedback to guide their willingness to actively challenge, point out the constraints of their behavior on the development of thinking, help them gradually develop the learning habit of positive thinking, complete homework seriously, and achieve a fundamental change in learning attitude.

Homework evaluation should resolutely put an end to the phenomenon of 'labeling' to avoid solidifying students' self-perception and limiting their development possibilities. Teachers should base their progress on students, construct an evaluation context for cultivating their core mathematical competencies, and allow students to find a fulcrum for self-breakthrough through evaluation words.

Mathematics homework evaluation under the guidance of a growth mindset must follow the principles of being detailed, specific, and clear in content expression. Regarding students' strengths, vague expressions should be avoided, and generalized evaluations such as 'very good' and 'not bad' should be avoided. Homework evaluation language should take into account the dual functions of diagnosis and motivation. It should not only objectively reflect the actual situation of the homework and point out the specific causes of errors and improvement paths but also encourage students to actively face challenges and cultivate their growth mindset.

Appropriate use of evaluation language can turn the evaluation process into an educational opportunity. For students who are afraid of more complex problems, the evaluation should accurately capture the traces of their potential attempts (such as the rationality of partial ideas, enthusiasm in the attempt process, etc.), strengthen their self-efficacy with more specific and clear evaluations, and guide them to target their knowledge loopholes and deficiencies, encourage them to actively face challenges, and gradually build up the courage to face difficulties and the ability to solve problems.

This study focuses on the core research question, 'How to design a feedback mechanism for long-term mathematics homework evaluation based on growth mindset', and responds to it by designing research tools and strategies. The setting of the 'Error Reflection Section for Homework' in Research Tool 3 guides students to conduct in-depth analysis and self-reflection on the mistakes in their homework from the student level; the 'Growth Mindset-Oriented Evaluation and Feedback Strategies for Long-Term Mathematics Homework' included in Research Tool 4 builds a targeted feedback system from the perspective of teacher evaluation. Together, the two aforementioned components constitute the core design elements of the evaluation and feedback mechanism for long-term mathematics homework under the guidance of a growth mindset, providing support at the practical operational level for the solution to the research question.

3.2 Process of the Intervention

3.2.1 Core Cycle Workflow

(1) Homework Submission

All students submit this week's mathematics long-term homework every Friday.

(2) Teacher Evaluation & Error reflection

Teachers completed grading within 48 hours, explicitly annotating error types and knowledge gaps.

Students concurrently completed the error reflection appended to assignments, requiring four standardized components: problem item, error root cause, correct solution pathway, and actionable improvement plan.

(3) Feedback Integration

The teacher fed back the homework evaluation results and guidance on the error reflection section to students, assisting students in deepening their understanding of homework errors and correcting their subsequent homework behaviors.

3.2.2 Data Collection & Qualitative Validation

(1) Process Documentation

Reflection worksheets were collected immediately post-cycle, anonymized and archive them for the purpose of conducting longitudinal tracking of students' cognitive changes.

(2) Post-Intervention Interviews

After Cycle 4, purposive sampling selected 6 students for semi-structured interviews.

Semi-structured interviews explored three thematic domains: learning experiences during the intervention, the evolution of perceptions of errors, and shifts in attitudes toward mathematics.

4. Results and Discussion

4.1 Implementation of Growth-Mindset-Oriented Evaluation Feedback Mechanism

4.1.1 Execution of Evaluation Feedback Strategies

Teachers use the above evaluation and feedback strategies to evaluate students' homework, and each homework evaluation is fed back to students on the same day, thereby ensuring the effectiveness and timeliness of homework evaluation. Specific evaluation cases are as follows:

12. (9 points) As shown in the figure, in $\triangle ABC$, D is the midpoint of AC . Draw DE perpendicular to AC through point D , intersecting BC at point E . Draw AF parallel to BC through point A , intersecting DE at point F . Connect AE and CF .

(1) Prove that quadrilateral $AECF$ is a rhombus.

(2) If $CF = 2$, $\angle FAC = 30^\circ$, $\angle B = 45^\circ$, find the length of AB .

Handwritten notes:

- since D is the midpoint of AC , $DE \perp AC$.
- Therefore, $AE = AF$, $AF = CF$. *Can we conclude $\angle 2$?*
- Thus $\angle DEA = \angle DFA$. *What line segment from point A perpendicular to BE, where $AD \perp BE$.*
- since $\angle DFA = \angle DFC$. *Which line segment from point A perpendicular to BE, where $AD \perp BE$.*
- since $\angle DEA = \angle DFA$. *Since AC is perpendicular and bisected, then: any point on the perpendicular bisector of AC is equidistant from A and C .*
- Thus $\angle DFA = \angle DFC$.
- Thus $\angle DFC = \angle DFA$.
- Thus $AE \parallel FC$.
- Since $AF \parallel BC$ and $AE \parallel FC$, to distinguish this.
- Therefore, $AECF$ is a rhombus. *carefully!*

Additional notes:

- The conclusion here holds true, but the method of proof is yet to be considered!
- Have another try and see what "method" can be used to prove it.
- Keep going!

Final calculation:

since $\angle ABD = 60^\circ$
 thus $\angle DAE = 30^\circ$
 since $AE = 2$, $\angle DAE = 30^\circ$
 thus $AD = 1$
 since $\angle BAE = 45^\circ$, $\angle DAE = 30^\circ$
 thus $\angle BAD = 45^\circ$
 $BD = AD \sqrt{2}$
 It follows from the Pythagorean theorem that
 $AB = \sqrt{(AD)^2 + (BD)^2} = \sqrt{5}$. *Great job!*
 Thus we conclude that $AB = \sqrt{5}$.

Figure 1 Example of Evaluation

The figure above presents the teacher's homework evaluation, which is formulated based on students' performance in specific topics upon homework submission. Within this evaluation, the teacher first diagnoses issues in students' responses and identifies specific errors—i.e., confusion regarding the properties of perpendicular bisectors. Subsequently, the teacher addresses students' thinking biases, clarifies improvement directions, and guides them to conduct proofs from the perspective of angle equality. Furthermore, throughout the evaluation process, the teacher recognizes students' coherent problem-solving thinking and acknowledges their efforts. The aforementioned teacher evaluation embodies two core attributes of evaluation: its diagnostic nature—characterized by identifying specific errors, thinking biases, and improvement directions—and its motivational nature, which emphasizes the learning process and students' efforts.

4.1.2 Application of the Error Reflection Section

After receiving the teacher's evaluation and feedback on their homework, students complete the Error Reflection Section by analysing the errors and their types that occurred in each of their assignments. Teachers evaluate homework through diagnostic evaluation and motivational evaluation words, point out specific errors and thinking deviations for students, and provide directions for improvement. Students fill out the Error Reflection Section based on the teacher's evaluation, which is a re-reflection after the teacher's assessment. In this process, students further clarify their learning issues and define their improvement strategies.

4.2 Preliminary Effect Analysis of Evaluation Feedback Oriented Towards a Growth Mindset

4.2.1 Erroneous Cognition and Handling Methods: Based on Analysis of Reflection Sections

An overall analysis was conducted on the error reflection sections of 17 students, with the main analysis content including changes in the word count and depth of their error reflections, changes in attribution of errors (attributing to ability versus attributing to effort and strategies), and changes in adjustment of improvement strategies. By analyzing three dimensions of students' reflection sections, the study investigates changes in students' cognition of and handling of errors to address Research Question 2.

First, reflect on the word count and depth of reflection. By observing the changes in students' reflective word counts overall, it was found that 76% of students showed a trend of increasing word counts progressively or significantly in later stages. The main manifestations include: in the initial phase (1-2 times), the single-dimensional answers in the reflection section were mostly 5-15 characters, often consisting of general descriptions. For example, student Szl described it as 'won't do' and 'no ideas', while student Sdy described it as 'can't write, can't understand the problem'. However, there were also a very few students who could provide detailed descriptions of more than 15 characters. But in the later stage of reflection (3-4 times), 82% of students were able to exceed 20 characters in their single-dimensional reflections and include specific error segments and related knowledge points. For instance, student Sdm added in the fourth reflection: 'The properties of squares, parallelograms, and rhombuses were not remembered clearly; they are always mixed up.' Additionally, the proportion of students whose depth of reflection has improved is 65%, from simply locating performance errors to pointing out erroneous links and knowledge loopholes. The main manifestations include: in the initial reflections (1-2 times), many students only pointed out the location of errors (e.g., 'can't do the last question, stuck on the proof question') without specifying the exact type of calculation or steps. However, in the later stage of reflection (3-4 times), students were able to subdivide the specific types of their own errors, such as 'don't know how to draw auxiliary lines for geometry problems' and

‘don’t know the cross-multiplication method’. The specific classification criteria for reflective word counts and the grading criteria for reflection depth are shown in Table 1 and Table 2, respectively.

Table 1 Classification Criteria for Reflection Word Count

Word Count Level	Criteria	Typical Case (Student Response)
Level 1 (Very Few)	≤10 words	Only use extremely concise expressions such as ‘Don’t know’ and ‘No idea.’
Level 2 (Few)	11-20 words	Can identify the type of error (e.g., ‘Mistake in solving the equation’) but without details.
Level 3 (Moderate)	21-30 words	Can clarify the specific part of the error (e.g., ‘Forgot steps when solving the equation’).
Level 4 (Many)	> 30 words	Can relate to specific knowledge points (e.g., ‘Forgot steps when solving the equation and didn’t memorize the formula well’).

Table 2 Classification Criteria for Reflection Depth

Depth Level	Definition	Typical Case (Student Response)
Level 1 (Surface)	Only locates the error position without referring to knowledge points	‘Got completely stuck at Step 2.’
Level 2 (Basic)	Clearly identifies the error type without associating with knowledge points	‘Got completely stuck at the last step and don’t quite understand the steps of this type of problem.’
Level 3 (Moderate)	Refers to specific knowledge points but without error analysis	‘Had no idea about the second part of the proof problem and am not proficient in this type of problem.’
Level 4 (In-depth)	Refers to specific knowledge points and conducts error analysis	‘Couldn’t draw auxiliary lines because confused the properties of squares, parallelograms, and rhombuses.’

Based on the depth of reflection and the count of words in the four reflections of 17 students, a distribution trend chart was made, as shown in Figures 2 and 3.

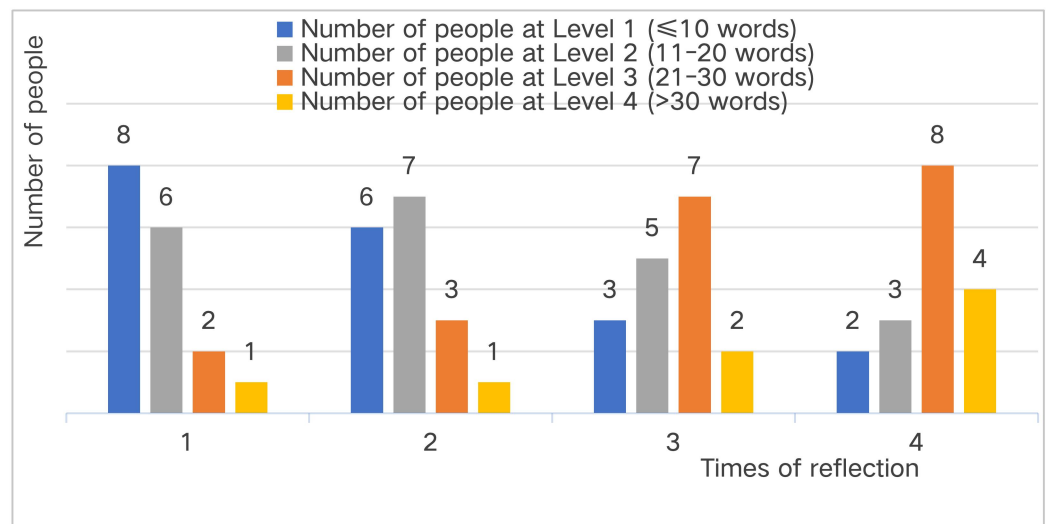


Figure 2 Distribution Trend Chart of ‘Depth’ in the Reflection

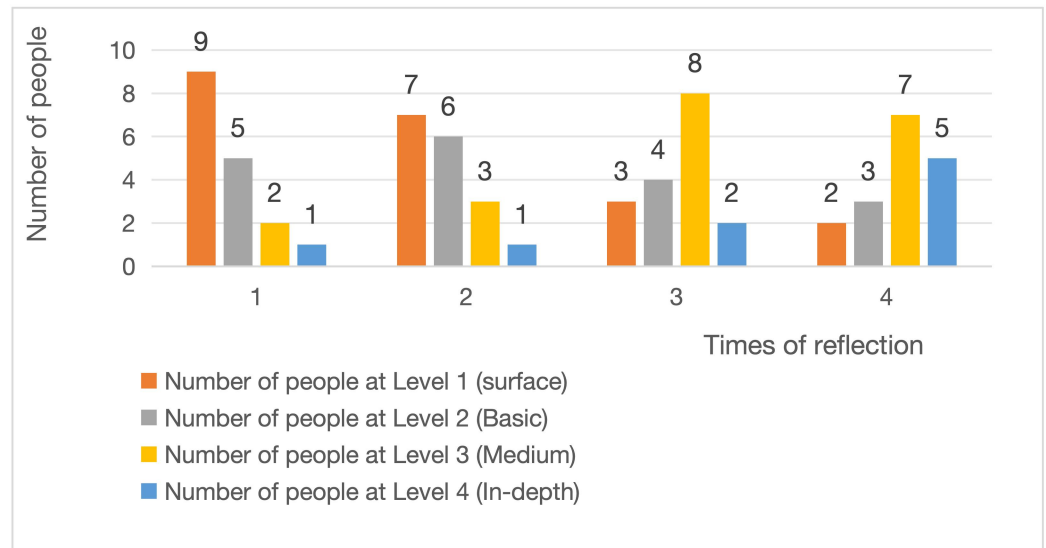


Figure 3 Distribution Trend Chart of ‘Word Count Level’ in the Reflection

As can be observed from Figure 2, with the increase in the number of reflections, the number of individuals whose ‘word count level’ was at Level 1 gradually decreased, while the number of those with a ‘word count level’ of Level 3 or 4 gradually increased. According to Figure 3, it is found that as the number of reflections increases, the number of individuals whose ‘depth level’ was at Level 1 decreased from 9 to 2, while the number of those with a ‘depth level’ of Level 3 or 4 gradually increased.

By observing students’ responses to the question in the reflection section, ‘Why does this error occur?’ we determine whether students attributed the error to insufficient effort or inappropriate strategies, or to inadequate ability. First, clarify the classification criteria for the two types of attributions, as shown in Table 3.

Table 3 Classification Criteria for Attribution of Errors

Attribution	Core Features	Specific Examples
Inability Attribution	Attributes to ‘limited own ability’ or ‘excessively difficult subject’, reflecting a fixed mindset	‘Don’t know’, ‘No idea’, ‘Mathematics is too difficult’, etc.
Effort or Improper Strategy Attribution	Attributes to ‘insufficient effort’ or ‘strategic errors’, reflecting a growth mindset	‘Forgot the calculation formula’, ‘Overlooked implicit conditions’

Then, the attribution of students’ errors was statistically analyzed. It was found that as the number of reflection sessions increased, the proportion of students attributing errors to ‘inadequate ability’ first stabilized and then decreased, while the number of students attributing errors to ‘insufficient effort or inappropriate strategies’ remained dominant throughout. The main manifestations include: during the initial error attribution phase (1-2 sessions), 35% of students attributed errors to inadequate ability; however, in the later attribution phase (3-4 sessions), this proportion dropped to 18%. The specific distribution trend is shown in Figure 4.

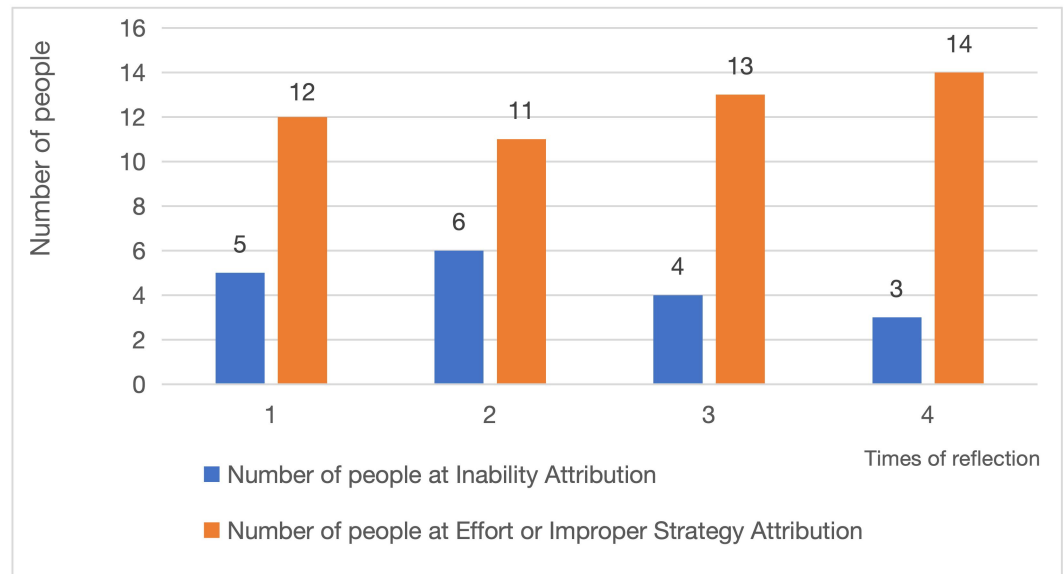


Figure 4 Distribution Trend Chart of ‘Attribution of Errors’ in the Reflection

Finally, the analysis of strategy adjustment reflection is presented. Based on the questions in the reflection section, the targeting and operability of the strategy adjustments proposed by students are observed. First, according to the students’ reflection situations, the types of strategies proposed by students are categorized, as shown in Table 4.

Table 4 Classification Criteria for Strategy Types

Strategy Type	Core Features	Specific Examples
Vague Slogan-type	Only proposes directions without specific implementation details	‘Carefully examine the questions’, ‘Read questions more and think diligently’, ‘Wait for the teacher to explain’
Specific Operable-type	Strategies can be directly implemented, including specific behaviors matched with errors	‘Mark and underline when reading questions’, ‘Prepare an error notebook to organize mistakes and write explanations’, ‘Calculate several times for computation problems’

A statistical analysis was conducted on the expressions related to ‘strategy adjustment’ in the error reflection sections of 4 assignments from 17 students. In the early stage of reflection (1-2 times), nearly 88% of the students proposed strategies of the ‘vague slogan type’. However, in the later phase of reflection (3-4 times), this proportion decreased to 24%, with the remaining students’ adjustment strategies being identifiable as specific and actionable.

In general, through the practice of the error reflection sections, the students’ reflection word count and depth demonstrated an overall increasing trend; in terms of the attribution of errors in homework, the attribution of lack of ability has decreased, and the attribution of strategy or effort continues to dominate; in terms of the performance of strategy adjustment, the specificity and operability of proposed strategies have significantly increased.

4.2.2 Impact of Students’ Perception and Attitude: Analysis Based on Interview Data

This study selected 5 students to conduct interviews, transcribed and analyzed the interview recordings, extracted students' views on evaluation methods and feelings about mistakes, and then explored the impact of comments and reflection columns on students to answer research the third question.

Students generally recognized the 'targeted' and 'motivating' evaluation method and believed that this assignment evaluation was different from the traditional teacher evaluation in the past, mainly reflected in the following two aspects.

1. Evaluation has shifted from 'judgment of right and wrong' to 'process guidance'. Most of the traditional evaluation methods are based on symbols such as '√' and '×', and the evaluation is relatively general. However, this homework evaluation is more targeted and instructive. In the interview, student Sdm pointed out that this assignment evaluation 'written down all my questions in detail', while student Szzx emphasized in the interview that 'each question explained in detail what was wrong', which is different from the traditional evaluation where the teacher only gives vague feedback on the results without distinguishing between right and wrong. Students believe that this type of evaluation is more targeted. For example, student Sdm pointed out in the interview that teachers give 'one comment per person' during evaluation, and at the same time analyze and give clear feedback based on specific questions during individual responses.

Such evaluations can accurately pinpoint problems. Shyz mentioned that 'the teacher can find out the mistakes, and you can more clearly understand where you went wrong next time.' Student Ssxf pointed out that the evaluation allows you to clarify the specific problems of 'unclear expressions in big questions and skipped steps in calculation questions.'

2. Evaluations are more motivating and reduce students' anxiety about making mistakes. Students pointed out in interviews that such evaluations are more 'approachable' compared to previous ones. Student Swyh noted, 'Teachers are usually quite strict, but this one during the summer feels more approachable,' believing that with this type of evaluation, 'you won't worry even if you get things wrong,' thereby reducing anxiety regarding evaluations and homework errors. Ssxf explicitly mentioned that the evaluations 'mostly encourage us, and if there are areas needing improvement, they point out the direction for rectification.' Both students Swyh and Shyz stated that the 'praiseful words' and 'encouraging tone' in the evaluations made them more willing to accept feedback and make corrections.

Attitudes toward mistakes have shifted from 'passive' to 'active.' Through interviews, it was found that students' attitudes toward mistakes in math homework are no longer negative; instead, they have developed a positive cognition that 'mistakes are valuable and can help with personal progress.'

Firstly, all students in the interviews believed that 'mistakes are a good thing,' as they help identify their own shortcomings, and after addressing these shortcomings, they can achieve progress. For instance, student Sdm stated, 'After making a mistake, I learn something, and I can also improve myself,' believing that mistakes help him 'identify where the deficiencies are.' Student Swyh directly expressed, 'Mistakes themselves are not scary; after discovering them and making improvements, that is progress.' Additionally, students noted that 'making mistakes helps discover where the inadequacies are and where improvements are needed, which is the greatest help for oneself.' Secondly, regarding how students respond to mistakes, there has been a shift from passive correction to actively solving problems. Interviews revealed that based on their recognition of the value of mistakes, students take proactive measures to address them. Student Sdm mentioned in the interview that he 'prepares a dedicated error notebook, sorts out mistakes, and seeks help'; student Shyz indicated that after discovering mistakes and difficulties, he 'solves errors in distribution problems through repeated deduction.'

4.2.3 The Impact of Teacher Evaluation and Reflection Sections on Students

The teacher evaluation and homework error reflection sections create a two-way interactive relationship, exerting a positive influence on students' learning behaviors and cognitive processes, primarily manifested in the following aspects:

Firstly, they assist students in clarifying improvement directions and enhancing their problem-solving abilities and reflective awareness. Teachers' comments enable students to accurately identify issues and clearly define paths for homework improvement. In interviews, all students mentioned that comments helped them 'better understand where the problems were,' such as student Sxxf, who, based on the comments, explicitly recognized the need to 'focus on practicing linear function question types,' thereby avoiding the confusion in traditional learning of 'not knowing where the mistake was or how to correct it.' Furthermore, teacher evaluations deepen students' understanding of knowledge. Student Shyz noted through comparison that improvements guided by comments 'understood more thoroughly than searching for answers,' as 'teachers write out the thought process, which can be used to solve similar problems,' surpassing the rigid theories in answer explanations.

Secondly, the reflection section strengthens students' proactive ability to organize and reflect. Students pointed out in interviews that the reflection section was 'useful' in helping them 'deeply understand where the mistakes were,' and the gradual enhancement of their reflection depth reflects an improvement in their reflective awareness. Evaluations and reflections can stimulate students' learning motivation and enhance their learning confidence. Interviews revealed that after receiving teachers' evaluation feedback, students would 'be more motivated to complete the homework,' increasing their initiatives in homework completion and changing their passive attitude toward math assignments. Additionally, students Sxxf and Sdm both reduced their anxiety toward math homework due to teachers' evaluations providing 'clear directions for improvement.'

Interviews further explain the positive experiences brought to students by the homework feedback mechanism under a growth mindset perspective. Students generally recognize more targeted and encouraging evaluation methods. The practical implementation of the junior high school mathematics homework evaluation feedback mechanism under the growth mindset perspective not only addresses the problem of traditional evaluation focusing on results over processes but also helps students reduce anxiety about math errors, enabling them to utilize errors as opportunities for growth. While clarifying improvement directions, it stimulates students' initiatives and confidence in math learning, further cultivating their growth mindset in a reverse manner.

4.3 Comprehensive Case Analysis

This study selects the case of one student, S2, for comprehensive analysis to explore the transformation trajectory of his cognition and attitude. Integrate the student's growth mindset scale scores, analyze the change process of the reflection column for the four mistakes, and integrate the key changes in the reflection column with the teacher's comment examples. Finally, the change in his mentality is further confirmed through interviews.

The Growth Mindset Scale is scored out of 120 points, with higher scores indicating a greater tendency toward a growth mindset. In this survey, the mean total score of the thinking questionnaire was 101 points, while student S2 scored 82 points, indicating an initial fixed mindset. Through four teacher homework evaluation interventions and reflection column guidance, the study gradually guided students' attribution to strategy and effort attribution, formed a positive understanding of the value of errors, guided positive changes in their thinking patterns, and further cultivated their growth mindset.

Stage 1: In the initial state, reflection is relatively general, and passive responses to errors are made. In this stage (1-2 reflections), S2's error reflection focused on the

description of superficial phenomena, without in-depth analysis of error causes and improvement strategies.

Error Reflection		Error Reflection	
Question	Answer	Question	Answer
1. Where does the error occur/Where is it stuck?	I got stuck at the third step.	1. Where does the error occur/Where is it stuck?	I missed steps when solving the equation.
2. Why does this error occur/Why here?	For the proof problem, I was not clear on the properties of a parallelogram.	2. Why does this error occur/Why here?	I overlooked implicit conditions.
3. Correct solution/Can other strategies be used?	Consult the teacher and refer to reference materials.	3. Correct solution/Can other strategies be used?	I asked the teacher for guidance ASK teacher.
4. How should we adjust if similar problems occur next time?	When working through questions, carefully highlight the key terms.	4. How should we adjust if similar problems occur next time?	Double-check carefully when working on calculation problems.

Figure 5 Reflection situation of S2 in Stage 1

The figure above shows the student's performance during this stage of reflection. It can be found that the first reflection did not explain the error location of the specific question, and the improvement measures only included 'asking the teacher or consulting the information' which lacked specificity and operability; the second reflection also summarized the errors with 'forgetting the steps' and 'ignoring the implicit conditions', and the adjustment plan was only 'careful inspection' and lacked specific operability.

Stage 2: Cognitive Intervention Phase, where the teacher provides evaluative guidance and motivation. In this phase, the teacher offers diagnostic evaluations for S2's homework, not only pointing out the reasons for the specific errors, but also guiding students to improve directions and adjust strategies, adjusting the evaluation method that emphasized results over process in previous evaluations. At the same time, attention is paid to motivational statements in homework evaluation to further cultivate students' growth mindset in actively facing mathematical challenges.

10. As shown in the figure, in rhombus $ABCD$, diagonals AC and BD intersect at point O . Draw $DE \perp BD$ through point D , intersecting the extension of BA at point E .

(1) Prove that quadrilateral $ACDE$ is a parallelogram;
 (2) If $BE = 10$ and $BD = 6$, find the area of rhombus $ABCD$.

Handwritten student work:

1) Since $ABCD$ is a rhombus.
 Thus $DC \parallel AB$, $DA \parallel CB$.
 Since $AC \perp BD$
 Thus $AB \parallel CD$, $\angle AOB = 90^\circ$
 Since $DE \perp BD$
 Thus $\angle EDB = 90^\circ$.
 Thus $\angle AOB = \angle EDB$
 Thus $DE \parallel AC$.
 Thus the quadrilateral $ACDE$ is a parallelogram.
 as well as the properties and criteria for determining a parallelogram!
 Fantastic!

Handwritten teacher annotations:

2) The quadrilateral $ACDE$ is a parallelogram, $BE = 10$,
 $DE \parallel AC$, $DC \parallel AE$. Make sure to clarify the $BE = 10$ cause-and-effect relationships in your proof.
 The quadrilateral $ABCD$ is a rhombus. Avoid more accumulation of statements without logical connections!
 Thus $AC \perp BD$, $AD = AB = BC$
 $OD = 3$. How is the derived? Make sure to clearly explain the reasoning process!
 Thus $ED \perp BD$
 Thus $\angle E = \angle ACB = \angle CAB = \angle ADB = 90^\circ$.
 Thus $AD \parallel CE$.
 Thus $ACDE$ is a parallelogram.
 In $Rt\triangle AOD$, $OA = \sqrt{AD^2 - OD^2} = \sqrt{5^2 - 3^2} = 4$.
 The result is correct! But how does the "5" come from?
 Thus, $S_{ABCD} = \frac{1}{2} DB \cdot AC = \frac{1}{2} \times 6 \times 8 = 24$.
 You're almost ready to discover the result!
 Let's recognize your thinking again: first, what can be derived from the parallelogram?
 How should the conditions for a rhombus be applied?
 Keep going! Your teacher believes in you!
 Haha!! go go go!!

Calculate

(1) $\sqrt{(-2)^2} + |1 - \sqrt{2}| - \sqrt{8}$ (2) $3(x-5)^2 = 2(x-5)$

Explain: $= 2 + \sqrt{2} - 1 - 2\sqrt{2}$ Explain: $\cdot 3(x^2 - 10x + 25) = 2x - 10$

Great! You have mastered how to calculate square roots and remove absolute values.

(3) $2\sqrt{12} \times \frac{\sqrt{3}}{4} + \sqrt{24} \div \sqrt{6}$ (4) $x^2 - 4x - 7 = 0$

Explain: $= 4\sqrt{3} \times \frac{\sqrt{3}}{4} + 2$ Explain: $a=1, b=-4, c=-7$

$= 3 + 2$
 $= 5$

You have mastered the order of operations. Perfect!

$3x^2 + 30x + 75 = 2x - 10$
 $3x^2 + 28x - 65 = 0$
 $a=3, b=28, c=-65$
 $\Delta = b^2 - 4ac = 4$ Be careful!

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-28 \pm 2}{6}$ Think about whether other methods can be used.

$x_1 = -4, x_2 = -5$

Be careful and patient with solving equations.

Keep trying and don't give up!
Or is there a simpler way to solve it?

Figure 6 Example of teacher’s evaluation of S2’s homework

The teacher first analyzes the errors in students' homework, gives diagnostic evaluation, and then gives suggestions for improvement. It is worth noting that the evaluation given by the teacher when praising the students for correct completion is also targeted, avoiding general evaluation of the students' abilities, but praising the students' efforts and strategies. (e.g., ‘You’ve mastered square roots and absolute value removal! Well done!’).

Teachers' evaluation and guidance can effectively promote students' cognitive changes. Students mentioned in the interview that ‘I have never seen this kind of comments before, and I feel that I can see where the mistake is, and I want to try to do what the teacher suggested.’ This shows that the evaluation feedback given by teachers can trigger students' willingness to actively adjust.

Stage 3: Deepening Transformation, Specific Reflection, and Precise Error Dissection. It was observed that the reflection column of S2 gradually shifted from a general summary of errors to a precise dismantling of errors: in the third reflection, it was clearly pointed out that ‘similar triangles cannot be found when drawing auxiliary lines,’ which was attributed to ‘confusion of the rhombus area formula,’ and a specific strategy of ‘two-way derivation’ was proposed; in the fourth reflection, improvement measures were further refined, including ‘reviewing data and organizing formulas,’ ‘calculating equations more times and correcting them in time,’ etc. See the figure below for specific reflections.

Error Reflection	
Question	Answer
1. Where does the error occur/Where is it stuck?	I couldn't identify the similar triangles using the auxiliary lines in the circle.
2. Why does this error occur/Why here?	I couldn't match the corresponding sides and angles; Also confused the area formula of a rhombus and mistaken implicit condition.
3. Correct solution/Can other strategies be used?	Organize the formulas: For proof problems, I can first prove the angles or sides before proving the figure is a rhombus.
4. How should we adjust if similar problems occur next time?	For proof problems, I can derive in both directions; I will also practice more related questions.

Error Reflection	
Question	Answer
1. Where does the error occur/Where is it stuck?	When solving the equation, I forgot the steps; after applying the formula, I couldn't get the result and miscalculated the outcome.
2. Why does this error occur/Why here?	I forgot the calculation formula and missed the solution steps for this type of problem.
3. Correct solution/Can other strategies be used?	I will consult the reference materials, highlight the conditions in the problem, and organize the formula.
4. How should we adjust if similar problems occur next time?	For calculation problems, I will check carefully; when solving equations, I will calculate multiple times and correct the wrong parts promptly.

Figure 7 Reflection situation of S2 in Stage 3

An analysis table on the changes in indicators related to the number of reflective words, depth of reflection, error attribution, and strategy adjustment in the S2 reflection section.

Table 5 Reflection changes of S2

Number of Reflections	Average Word Count of Reflection	Reflection Depth	Error Attribution	Strategy Adjustment
1	10.25 words	Level 3	Effort Attribution: Knowledge Deficiency	Vague, External Help
2	9.25 words	Level 3	Effort Attribution: Skill Insufficiency, Attitude Habit	Vague, External Help
3	14 words	Level 4	Effort and Strategy Attribution: Knowledge Deficiency, Attitude Habit, Method Deficiency	Specific, Practice Reinforcement
4	17 words	Level 4	Effort and Strategy Attribution: Knowledge Deficiency, Skill Insufficiency	Specific, External Help, Practice Reinforcement, Active Challenge

Stage 4: Consolidate cognitive development, accept errors, recognize the value of errors, and actively confront mathematical challenges. After the teacher's evaluation and reflection task, student S2's understanding of mistakes gradually transformed into 'opportunities for improvement.' He made it clear in the interview that 'mistakes are a good thing, and you will be fine if you correct them.' In addition, for challenging tasks in mathematics homework, after students receive motivational and diagnostic comments from teachers, they can further actively think and dare to try. Students pointed out in the interview that 'comments can encourage me to want to complete this task more.'

According to the students' transformation at different stages and combined with their thinking characteristics, examples of their specific performance are compiled, as shown in the table below.

Table 6 S2's mindset characteristics and performance at different stages

Stage	Mindset Characteristics	Performance Examples
T1 Initial State	Mindset tends to be fixed, with insufficient recognition of the value of errors	The score on the Growth Mindset Scale is 82, with a full score of 120. Reflection: 'Got stuck at the third question' (Unclear willingness to improve)
T2 Key Intervention	Teacher's evaluation feedback triggers cognitive change	Teacher's comments: 'You used the formula method, but be careful! You can also think about other methods?'; 'Clarify the causal relationship of the parallelogram and think carefully about where the length of OA comes from?' Interview: 'This kind of comment makes me more willing to complete this assignment.'
T3 Reflection Shift	Reflection depth increases, strategy adjustment becomes more specific and operable	Reflection: 'Forgot specific steps when solving the equation, couldn't get the result after using the formula.'; 'Couldn't find similar triangles after drawing auxiliary lines.'; 'Confused the area formula of a

T4 Stable Growth

Recognizes the value of errors and proactively responds to challenges

rhombus.’ (Error positioning is deeper, attribution points to specific strategies)

Reflection: ‘Try bidirectional deduction for proof problems’; ‘Calculate several times when solving equations and correct mistakes in time.’ (Proactively attempt with willingness to take on challenges)

Interview: ‘Making mistakes lets me know where my problems are, so I can make progress.’

5. Conclusion and Suggestion

5.1 Evaluation and Feedback Mechanism for Mathematics Long-term Homework Oriented towards a Growth Mindset

This study designed an ‘Error Reflection Section’ in the summer mathematics long-term homework, aiming to reshape students’ cognition of errors and enable them to complete a self-directed inquiry process of ‘Identifying Errors—Analyzing Errors—Learning from Errors.’ Using the long homework evaluation strategy from the perspective of growth mindset, teachers point out the direction of improvement for students’ mistakes in their homework, encourage them to actively face challenges, and further cultivate their growth mindset. In addition, teachers can also observe students’ understanding of errors through students’ homework error reflection columns, so as to adjust the evaluation language. Teachers’ evaluation comments can promote and deepen students’ homework behaviors. A positive homework evaluation experience allows students to accumulate successful experiences and develop a proactive mindset towards challenges, thereby strengthening their growth mindset.

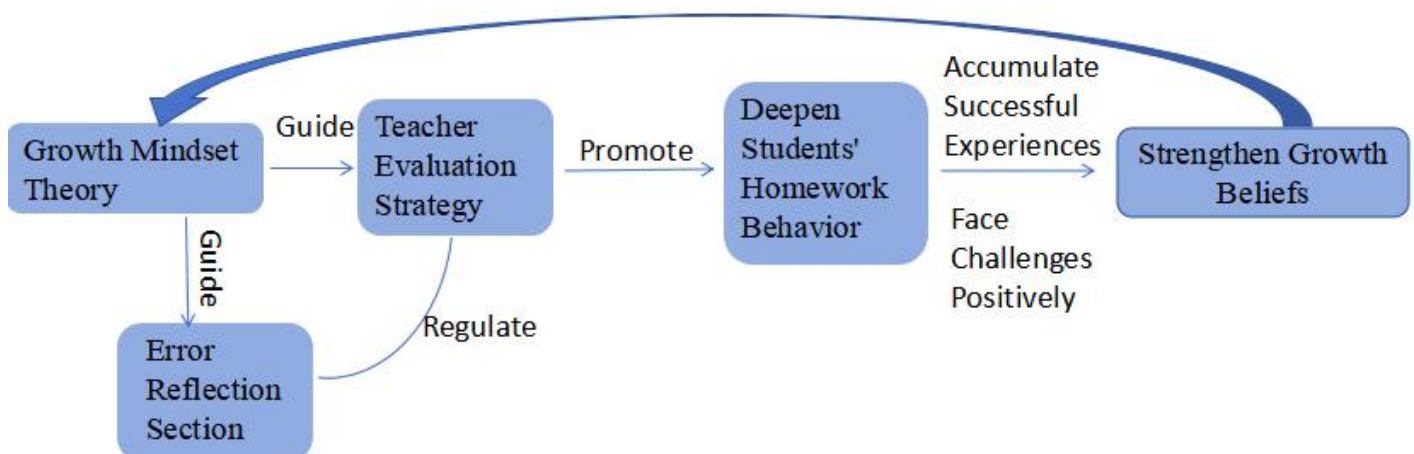


Figure 8 Growth Mindset-Oriented Evaluation and Feedback Mechanism for Long-Term Mathematics Homework

The findings should be interpreted with caution regarding causality. Rather than claiming that the intervention ‘caused’ the development of growth mindset, this study suggests a positive association between the intervention and the observed shifts in attribution patterns and reflection depth. Future research could adopt a quasi-experimental design with a control group to strengthen causal inference.

5.2 Associations Between Growth Mindset-Oriented Long-Term Mathematics Homework Evaluation and Students’ Error Handling

Despite the lack of an external control group, the detailed, stage-by-stage progression observed in the reflection entries and attribution shifts provides robust internal evidence for

the potential effectiveness of the intervention. Students' reflections evolved from general descriptions to specific, actionable reflections. This developmental trajectory aligns with the core tenets of growth mindset theory, which emphasizes the shift from ability-fixed to effort-oriented attribution. Furthermore, the interview data and reflection content analysis confirmed the consistency of these changes, strengthening the internal validity of the qualitative findings.

The study primarily influences students' error handling through an assignment evaluation feedback mechanism composed of an 'Error Reflection Section' and a 'Long-Term Homework Evaluation Strategy,' which mainly includes students' reflection performance, error attribution, and adjustment strategies. First, regarding reflection performance, both the word count and depth of students' reflections have increased; most students, in the later stages of reflection, are able to identify specific knowledge and analyze errors. From the perspective of error attribution, the number of students attributing errors to 'inadequate ability' showed a trend of first stabilizing and then declining, while the number of students attributing errors to 'insufficient effort or inappropriate strategies' remained dominant throughout. In terms of adjustment strategies, as the number of reflections increased, the specificity and operability of the strategies proposed by students became significantly stronger.

5.3 The Impact of the Mathematics Long-Term Homework Evaluation Feedback Mechanism on Students

After the practical operation of the evaluation feedback mechanism for long mathematics assignments, student interviews were used as an entry point to understand the impact of this mechanism on students. First, teachers' evaluation feedback helps students clarify improvement directions, enhancing their problem-solving abilities and reflection awareness. Second, the reflection further strengthens students' ability to actively reflect and deepens their understanding of the value of mistakes. Finally, the long-term homework evaluation feedback mechanism can stimulate students' learning motivation, enhance their learning confidence, and further cultivate their growth mindset.

5.4 Research Limitations and Future Directions

The evaluation and feedback mechanism for mathematics long-term homework oriented towards a growth mindset responds to the requirements of the Outline and The Compulsory Education Mathematics Curriculum Standards (2022 Edition), focusing on students' learning processes, their efforts, and progress. This study guides students to engage in in-depth reflection through the error reflection section, reshaping their cognition regarding the value of errors. This study uses diagnostic and motivational evaluation words to evaluate homework to further deepen students' homework completion behavior, encourage them to actively face challenging tasks, and further cultivate their growth mindset.

This study has limitations regarding sample size and generalizability. The sample comprises 32 students from one 8th-grade class of a junior high school in Cangzhou, among whom 17 completed the full reflections. The small sample size and regional specificity restrict the generalization of the research findings to a broader student population. Future research should expand the sample to multiple regions and schools as much as possible to increase the sample scale. Additionally, robust statistical analyses can be further conducted on large samples to explore the relationship between the long-term mathematics homework evaluation and feedback mechanism and growth mindset.

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