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ORIGINAL RESEARCH

Intervention on Mathematics Self-Efficacy: Solution-Focused Brief Therapy

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Purpose: Research has demonstrated a strong correlation between mathematics self-efficacy and math performance. Middle school children are increasingly receiving solution-focused brief therapy (SFBT), which is a type of psychotherapy. The study intends to use SFBT intervention to improve mathematics self-efficacy of students and to determine whether SFBT intervention was effective. To examine whether Rasch model can be used to evaluate students' mathematics self-efficacy.

Methods: This study intends to use Radar chart, Rasch model, Line chart to measure the variations of mathematics self-efficacy of three 8th graders (n=3) during SFBT intervention.

Results: Radar chart and Rasch model demonstrated a general increment in the mathematics self-efficacy of two pupils, while another one decreased. Additionally, three students showed a decline in their mathematics self-efficacy on particular mathematical problems using a line chart.

Conclusion: Overall, students with varied degrees of self-efficacy in math benefited from SFBT interventions, which partially supports the usefulness of SFBT as a tool for assessing students' mathematics self-efficacy. It supported that Rasch model can reflected the changes in students' mathematics self-efficacy. This study provides guidance for measuring the improvement of students' academic self-efficacy through SFBT intervention using Rasch model.

Keywords: mathematics self-efficacy, solution-focused brief therapy intervention, radar chart, wright map

Introduction

Academic underachievement of students is the most pressing problem facing in primary and secondary schools, and it is related to many factors, including anxiety, self-efficacy, and so on. Self-efficacy expectancies are significant in predicting academic accomplishment, which means that pupils are more likely to demonstrate safety and self-confidence, and they are also more likely to show higher levels of school achievement.[1] In the 21st century, parents, educators, researchers and policymakers broadly agree on the importance of mathematics for careers and active participation in daily life.[2] Research showed that students' academic performance and mathematics self-efficacy are highly correlated.[3] It has been proven that finding intervention and support services to improve at-risk youth's overall academic achievement in K–12 education is becoming increasingly important,[4] and psychotherapy is a useful strategy for improving individual's internal psychological traits and external performance, and one of the strategies is SFBT.

Solution-Focused Brief Therapy Intervention

Among the several psychotherapy systems, SFBT is a well-recognized and established strategy.[5] It is based on constructivism, interpersonal, communication, and systems theories.[6] At the Milwaukee Brief Family Treatment Centre in the early 1980s, Steve de Shazer et al developed SFBT.[7] The foundation of SFBT is solution-building as

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opposed to problem-solving,[8] and it is a strength-based solution designed to help individuals use their resources and internal desire to overcome challenges,[9] and how they could be applied to bring about positive transformation.[10]

According to SFBT, an understanding of the problem's roots is not (always) necessary, which refers to proposed solutions that frequently perpetuate the problem.[11] In SFBT, it is assumed that most issues arise from human interaction and that modifying these interactions can assist clients in making even tiny changes to their behavior.[7] In addition, therapists play a critical role in using the SFBT approach. Therapists view the re-establishment of meaning through languages and social interaction as a significant process of change,[6] and they frequently use scaling questions to help with goal creation as well as miracle questions.[12] The miracle question is a tactic for eliciting kids' objectives that acknowledges the issue's scale while simultaneously inspiring the kids to create more attainable, smaller objectives.[7] Scaling questions is also useful for at-risk adolescents to focus on goal development.[4]

Solution-Focused Brief Therapy Intervention in School Settings

In the past decade, the application of SFBT to children in educational contexts has drawn the attention of researchers and professionals working in schools.[13] Applying SFBT in school settings is a good fit in certain aspects because it is a technique that has been used in alternative educational environments and successfully resolves school problems among at-risk kids.[14] Since SFBT is brief and versatile in addressing a range of concerns, it appears to be a workable intervention that may be implemented and maintained in a learning environment.[13]

In empirical research, numerous studies support the use of SFBT in educational settings to improve students' performance. For example, Newsome[4] investigated how well SFBT worked for middle school children that were classified as high risk on attendance and academic issues. Franklin et al[15] used a quasi-experimental design study at two high schools to examine whether SFBT could help improve credits, attendance, and graduation rates. Froeschle et al[16] used experimental study to examine the effects of SFBT group sessions, coaching, and action learning techniques on adolescent girls' grade point average.

In a quasi-experimental study, Franklin et al[17] provided evidence that SFBT was successful in dealing with internalizing and externalizing behaviors in pupils in two middle schools. Sarvi and Ghazi[18] aimed to investigate the effectiveness of SFBT in improving the self-efficacy of fifth-grade female primary school students. Neipp et al[19] investigated how SFBT affected self-efficacy and other elements in the educational environment. They can offer theoretical and practical justification for applying SFBT in educational contexts. The present study also makes an effort to gauge students' mathematics self-efficacy using SFBT interventions.

Self-Efficacy and Mathematics Self-Efficacy

Social cognition theory proposed that self-efficacy beliefs were defined as individuals' opinions of their capabilities to perform assignments and accomplish objectives in a certain circumstance,[20] they affect people's thoughts, motives, emotional processes, and eventually their conduct.[21] People with high self-efficacy are more likely to show persistence when facing challenges, to be highly internally motivated to participate in and execute the assignment, and to show fewer disappointments in the event of a failure than those with low self-efficacy.[22] The self-efficacy level of individual has a significant impact on their success.[23] Self-efficacy is primarily separated into general self-efficacy and academic self-efficacy. Academic self-efficacy is a student's assessment of their capacity to meet educational objectives, and is approximately positively correlated with performance,[24] the same goes for subject-specific self-efficacy.

Mathematics self-efficacy is individual's beliefs in how one's actions and efforts could lead to success in math.[25] In addition, Betz and Hackett[26] invented the Mathematics Self-Efficacy Scale. Many scholars have conducted research on mathematics self-efficacy. Fast et al[27] agreed that kids with high mathematics self-efficacy calculate with more accuracy, and are able to persevere longer when challenging math problems. You et al[28] and Peters[29] proposed that kids with higher self-efficacy scores in math are also likely to do better in math.

Item Response Theory

Item Response Theory (IRT) is a strong and graceful performance test model that nearly eliminates all the drawbacks of standard test theory,[30] and it has gained a lot of traction as a foundation for psychological assessment.[31] IRT analysis

offers psychometric details on each item at each level of the concept being assessed.[32] It is a based-on theory psychological testing technique for analyzing item response categorization information usually gained via academic tests. Fundamental models of IRT (like Rasch model) describes the likelihood of correct response as a nonlinear function of pupils' latent talents and the item's complexity characteristics.[33]

Georg Rasch proposed Rasch model is a latent trait model[34] and it is a psychological measurement method that can increase the precision of tools built in academia, assess the quality of instruments, and calculate responders' performance, and it is often used as an assessment development in studies important to education.[35] By employing probability testing theories, Rasch model mainly manifests as the mechanism where the chances of individuals correctly answering questions depend on latent variables and desired outcomes,[36] and it also focuses on utilizing dimensionality and measurement invariance.[37] The primary advantage of Rasch model is that it converts binary raw data into a scale of intervals of the underlying characteristic, enabling linear comparisons between the intricacy of the item and the individual's capacity, which can be used to assess the construct validity of an evaluation.[36]

Wright map, also knowns as "Person-Map-Item", created using Rasch analysis, offers visual help for comprehending person and item correlations on an equal interval scale.[36] According to Wright Stone,[38] two requirements for objective measuring are included in Rasch model: (1) For any item, people with high ability should be more inclined to provide the right response than those with limited ability. (2) Anyone should continuously outperform themselves on simple tasks compared to more challenging ones.

Empirical research has also made some contributions to IRT or Rasch model. Hung[31] used the IRT to support the validity of the Creative Self-Efficacy assessment. For senior primary school kids, Sun et al[23] used IRT to analyze the psychological properties of the General Self-Efficacy Scale's Chinese version. Lee et al[39] employed multidimensional Rasch modeling to test the Chinese version of Motivated Strategies for Learning Questionnaire. By using Rasch analysis, Fan et al[36] investigated the psychometric characteristics by using the Self-Efficacy for Therapeutic Use of Self questionnaire in Noriega. The result is that IRT or Rasch model has not been widely utilized to assess self-efficacy in math for pupils.

Study Purpose

At present, it is unknown how well SFBT interventions affect children who are at risk for self-efficacy in math, and it has not been obvious whether Rasch model can track variations in students' self-efficacy in math. Therefore, the current research aims to track changes in students' self-efficacy in math to evaluate the effectiveness of SFBT intervention and determine if Rasch model can reliably capture pupils' mathematics self-efficacy. This paper attempts to address the following questions, (1) To identify how students' mathematics self-efficacy changes after SFBT intervention, (2) To explore whether Rasch model can gauge the variations of students' mathematics self-efficacy, (3) To verify whether SFBT is effective in improving students' mathematics self-efficacy.

Materials and Methods

Participants

Three pupils at risk of self-efficacy in math participated in the study, they come from an eight-grade classroom at a middle (K-12) school in Shang Qiu, Henan province, China. The school is located in rural areas, and the equipment is outdated. Many students are left-behind with poor academic performance. Potential participants are defined as those who "rank in the 30th percentile or less of the class". Ten students were initially identified as participants and 7 students were excluded due to over-performance in class and participation in extracurricular tutoring, and three were finally identified.

During the intervention time, none of the three kids attended a tutorial class. The Human Ethics Committee of Shandong Normal University has reviewed and approved the research of human participants. The participants and their parents provided their written informed consent to participate in this study. The performance of the three students is shown in Figure 1.

Participant 1 was a 15-year-old girl, labeled as FH, who had higher mathematics self-efficacy than the others. She was an introverted girl who does not like to communicate with others. It was easy for her to get distracted in class. FH had

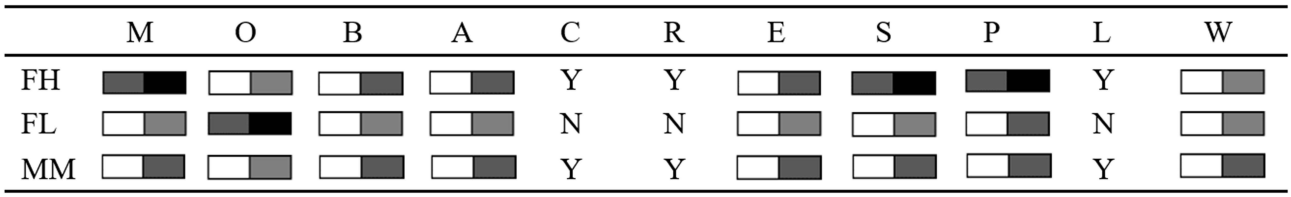

Figure 1 The performance of the three students FH FL MM.
Note: High, medium gray and black with black borders; Medium, white and medium gray with black borders; Low, white and light gray with black borders.
Abbreviations: M, Mathematics self-efficacy; O, Openness level; B, Basic knowledge; A, Mathematics achievement; C, Class participation in discussion; R, Review habit; E, Enthusiasm for math; S, Speed of solving problems; P, Problem-solving error rate; L, learning strategies; W, Willpower; Y, Yes; N, No.

general basic knowledge of math, and average math achievement in the class. She could participate in class discussions and had the habit of reviewing. For the whole class, FH's enthusiasm for math was average. She was quick at solving math problems, with a high problem-solving error rate. She had corresponding learning strategies and less strong willpower in math compared with her classmates.

Participant 2 was a 15-year-old girl, labeled as FL, who had slightly lower mathematics self-efficacy than the others. She was cheerful, quick to think, and enjoyed communication. FL had a high frequency of distractions in class because of her carelessness. She was relatively week in basic math knowledge and had poor math performance. She could not actively participate in class discussions either. FL had no habit of reviewing, and her enthusiasm for math was not high in her class. She was slow at solving math problems, with a medium problem-solving error rate. She had no learning strategies and poor willpower in math compared with her classmates.

Participant 3 was a 15-year-old boy, labeled as MM, and his mathematics self-efficacy was medium compared with the girls. He had an introverted personality and likes to play video games. MM was the math representative of the class, and he could concentrate in class but was easily distracted while studying. He had general basic knowledge of math, and average math achievement in the class. MM could participate in class discussions. He also had the habit of reviewing, and his enthusiasm for math was general. His speed at solving math problems was moderate, with a medium problem-solving error rate. Compared with his classmates, he had corresponding learning strategies and general willpower in math.

Design

A pre-service math teacher served as the intervention supervisor, and an associate professor provided alternative guidance. The professor is an expert in educational psychology with 20 years of research in Mathematics Educational Psychology while the pre-service math teacher is a graduate student with teaching and tutoring experience and the same research direction as the associate professor. She received training in two instructional intervention conditions, which include SFBT intervention and math problem-solving teaching intervention, respectively. The professor participated in the pre-test in the first few weeks, and provided numerous valuable recommendations in specific intervention sessions. The pre-service math teacher and professors are jointly researched the mathematical problems in the different fields.

In order to calculate the self-efficacy scores of mathematical problems to analyze the status quo of students, they are represented by line chart on a scale of 10 to 100, which is different in Bong and Hocevar.[40] This is mainly because students are familiar with mathematics course content, and the 100-score scale is always used to score subjects in China, which better reflects their self-efficacy in math. This is the rationale behind the application of response category ranges using a 7-point Likert scale in Motivated Strategies for Learning Questionnaire self-efficacy (MSLQ) self-efficacy[40] and Dimensions of Students' Mathematics Self-efficacy Questionnaire (DSMSQ),[41] whereas the response category ranges in specific math questions are different. For this reason, the first two questionnaires use Radar chart and Wright map, while the third scale makes use of line chart, respectively.

Data Analysis

The pupils' responses to these three questionnaires revealed their mathematics self-efficacy. After the kids completed MSLQ self-efficacy and DSMSQ, the experimenters gathered the test papers and used Excel tables to collect questionnaire data, using SPSS version 26.0 to measure the reliability of the questionnaire. MSLQ self-efficacy was

calculated using the forward scoring method. Since DSMSQ is divided into five parts, the first and fifth parts of the questionnaires are calculated using the reverse scoring method, and the remaining three parts are positive scores. When assigning scores to this data, all of them were changed to positive scores.

The pupils' self-efficacy in math used Radar chart and Wright map to gauge, representing performance on the MSLQ and DSMSQ of three students. In other words, Origin version 2022 represents the average score of students in the two questionnaires and it outputs Radar chart, while Winsteps 3.72.0 version outputs Wright map. Only 3 students' mathematics self-efficacy from 8 interventions measured by Wright map was shown in the article, and relevant information related to the reliability, validity, and fitting degree of the model were not displayed. MSLQ self-efficacy includes 3 fields, while DSMSQ includes 5 dimensions. Therefore, Radar chart and Wright map were divided into 8 dimensions for analysis.

In the current study, MSLQ self-efficacy and DSMSQ are tested with a 7-level scale, Radar chart can only show the changes in students' mathematics self-efficacy between the first intervention and the eighth intervention, but cannot show the dynamic changes in students' mathematics self-efficacy during the entire intervention period. Therefore, Wright map was used to measure the variation of persons and items. By comparing the students' average scores on the two sets of questionnaires, it is not possible to fully demonstrate the changes in students' mathematics self-efficacy. Therefore, a line chart is used to measure the changes in students' mathematics self-efficacy in specific questions. In sum, Radar charts, Wright maps, and line chart are used to describe the pupils' mathematics self-efficacy during SFBT intervention.

Measures

Motivated Strategies for Learning Questionnaire Self-Efficacy

Bong and Hocevar[40] originally proposed MSLQ self-efficacy, which mainly assesses students. The following six verses make up the whole section: "I'm certain that I can understand what is taught in class", "I expect to do very well in class", "I am sure that I can do an excellent job on the problems and tasks assigned for class", "I know that I will be able to learn the class material", "My study skills are excellent in class", and "I think I will receive a good grade in (subject) class". In the Mathematics Curriculum Standards for Compulsory Education (2022 Edition),[42] the mathematics content mainly consists of four fields: "Numbers and Algebra", "Graphics and Geometry", "Statistics and Probability", and "Synthesis and Practice". The field of "Synthesis and Practice" aims to cultivate kids' capability to utilize knowledge comprehensively and better solve problems. Given that the content of "Statistics and Probability" is easier than in other fields in junior high school, this field was removed.

For 6 items in the three fields of math, there are a total of 18 items. The Cronbach coefficient of the questionnaire is 0.848. Responses were categorized using the 7-point Likert scale, which goes from 1 (wholly disapprove) to 7 (absolutely approve). Pupils' self-efficacy in math increased in direct proportion to their questionnaire scores. The details of the questionnaire are shown in Appendix 1.

Dimensions of Students' Mathematics Self-Efficacy Questionnaire

Bagaka's[41] developed DSMSQ, and it was used to gauge kids' self-efficacy in math. It mostly has five dimensions, (1) students' lack of interest in and fear of mathematics (13 items); (2) students' relative competence in mathematics (9 items); (3) students' self-confidence and competence in mathematics (9 items); (4) students' interest in, effort in, and perception of the importance of mathematics (8 items); (5) students' mathematics anxiety (5 items). There are a total of 44 items in these dimensions and the Cronbach coefficient of the questionnaire is 0.926. Responses were classified using a 7-point Likert scale, where 1 denoted "completely disapprove", and 7 meant "complete agreement", representing the higher the students' level of mathematics self-efficacy, the better their grades. The questionnaire is included in Appendix 2.

Mathematical Problems in Different Field

The researchers prepared and discussed the following mathematical problems. In the fields of "Number and Algebra", "Graphics and Geometry" and "Synthesis and Practice", that include General-Math-Task-referenced self-efficacy

questions and Unconventional-Math-Problem-referenced self-efficacy questions. Each session includes 5 questions covering three fields.

The intervention consisted of 40 problems. The Cronbach coefficient of the questionnaire is 0.820 and the Expert validity is 0.865. However, the number of math questions across the three fields is uneven. Previous research has proved that the field of "Synthesis and Practice" in math can better report students' mathematics self-efficacy.[43] Therefore, the number of math problems in the Synthesis and Practice field is the highest.

In these items, students need to complete posing problems or solving problems. Before solving the problem, students need to estimate their self-confidence in resolving the problem, and then they can address the particular task. On a scale from 10 to 100 in increments of 10 units, students expressed how self-assured they were in their capabilities to accomplish the various types of assignments that were presented. The mathematical problems included in the specific field are shown in Table 1 below.

Solution-Focused Brief Therapy

Newsome[44] introduced SFBT, which is mainly divided into 8 sessions. Some changes were made in this study, and the specific details of each session are as follows.

Session 1. Introductions. Give permission after full notification. Talked about collective expectations and discussed the group's goals, which included math proficiency, classroom behavior, assignment completion rates, and attendance rates.

Session 2. In-Session assignment. Use miracle question in class to ask students: "What scholarly objectives in math do you have this term?" "What math accomplishments do you want to attain over the course of the next eight weeks with the group?" (For instance, imagine the miracle happens tonight the second you sleep and the problem that led you here today is resolved. But you were unconscious of the miracles as you fell asleep. Would you mind explaining what the morning would bring that would be different that would suggest a miracle has happened?)

Session 3. Use of the scaling question. The following problems occurred in the class: Where would you grade yourself as a student right now, on a scale from 1 to 10, where 1 represents not having accomplished your school goals in math, and 10 represents having done so entirely? Homework due the following week:

> What do you want your final semester grade to be? Afterward, discuss how you want to make this grow with the group (goal and future-focused).

Table 1 The Specific Fields in Mathematics Problems During 8 Interventions

Problems Fields Sessions	Problem 1	Problem 2	Problem 3	Problem 4	Problem 5
Session 1	Number and Algebra	Graphics and Geometry	Number and Algebra	Synthesis and Practice	Graphics and Geometry
Session 2	Graphics and Geometry	Number and Algebra	Synthesis and Practice	Synthesis and Practice	Synthesis and Practice
Session 3	Graphics and Geometry	Synthesis and Practice	Number and Algebra	Number and Algebra	Synthesis and Practice
Session 4	Synthesis and Practice	Synthesis and Practice	Graphics and Geometry	Number and Algebra	Synthesis and Practice
Session 5	Graphics and Geometry	Graphics and Geometry	Number and Algebra	Graphics and Geometry	Synthesis and Practice
Session 6	Synthesis and Practice	Graphics and Geometry	Synthesis and Practice	Number and Algebra	Number and Algebra
Session 7	Graphics and Geometry	Synthesis and Practice	Synthesis and Practice	Number and Algebra	Synthesis and Practice
Session 8	Graphics and Geometry	Graphics and Geometry	Synthesis and Practice	Graphics and Geometry	Number and Algebra

Session 4. Review the third session's homework assignment. Held a conversation in the group about the "signs of success" in accomplishing scholastic objectives in math. Homework for next week: The first question is,

> What do you think your math teacher would say if I questioned him or her about how he or she had witnessed these signs of success in your arithmetic scholarly objectives?. (Or the question of the relationship)

Second, "Please list your signs of success that helped you get closer to achieving your end-of-semester grade on a scale of 1 to 10".

Session 5. Review of the homework assignment for Session 4. Employed the EARS (elicit, amplify, reinforce, and start anew) SFBT technique. To highlight and support recent and impending change, the exception-finding question was employed.

Session 6. Consider the scaling question again. Daily task appears like this: The "older, wiser self" is writing a letter.[45]

> Imagine now that you are an elderly, wiser person who is taking a look back at this period of your life. What advice from this person would you take, and how did it assist you achieve your current math academic objectives?

Session 7. Going over the assignments from Session 6. Talked about the emergence of the "new" self: employ EARS. The homework task: "A letter from the future".

Session 8. Examining the task assignment from Session 7. Discussed the normality of setbacks. Passed out success certificates.

Procedure

Before the study began, the researchers have mastered the basic information about the three students from their teachers. In the pretest, only DSMSQ were utilized to evaluate the three pupils' self-efficacy in math. Through telephone interviews with parents and teachers, the researchers gathered demographic and biopsychosocial data, and they also described SFBT, the duration of intervention, and the intention of study. The participants were informed of the anonymity before they provided written authorization to participate in the study.

Following the pretest assessments, the same experimenter assigned the three participants. Due to COVID-19, the investigation was implemented via online counseling. The researcher introduced the project to a math teacher, and three participants volunteered to participate in the intervention project during the 2022 Winter Break Period.

The intervention included 8 sessions and each session consisted of three parts. The pre-service math teacher distributed questionnaires to students, including MSLQ self-efficacy and DSMSQ (~30 min), then asked the students 5 mathematical problems included in three fields (~ 45 min), and asked students questions in each session during SFBT intervention (~25 min). Each session lasted about 1 hour and 40 minutes, and it was held twice a week. It took 4 weeks to complete the intervention. The specific study procedure is shown in Figure 2.

Results

The Level of Student's Mathematics Self-Efficacy in Radar Chart

Figure 3 depicts Radar chart of the three students' 8-dimension self-efficacy in math, which shows a major alteration in the three pupils. As shown in Figure 3A, FH's self-efficacy in math was much lower in the posttest than it was in the

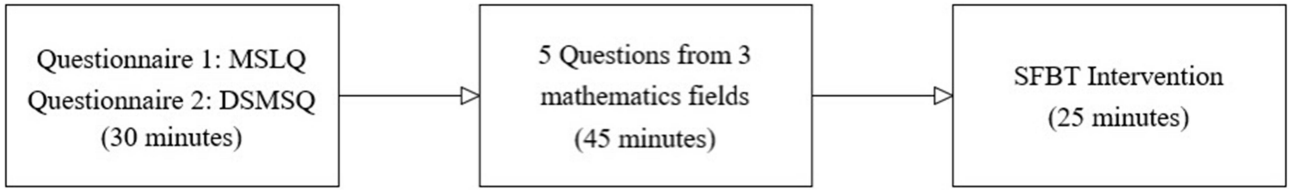

Figure 2 Flow chart of the study procedure.

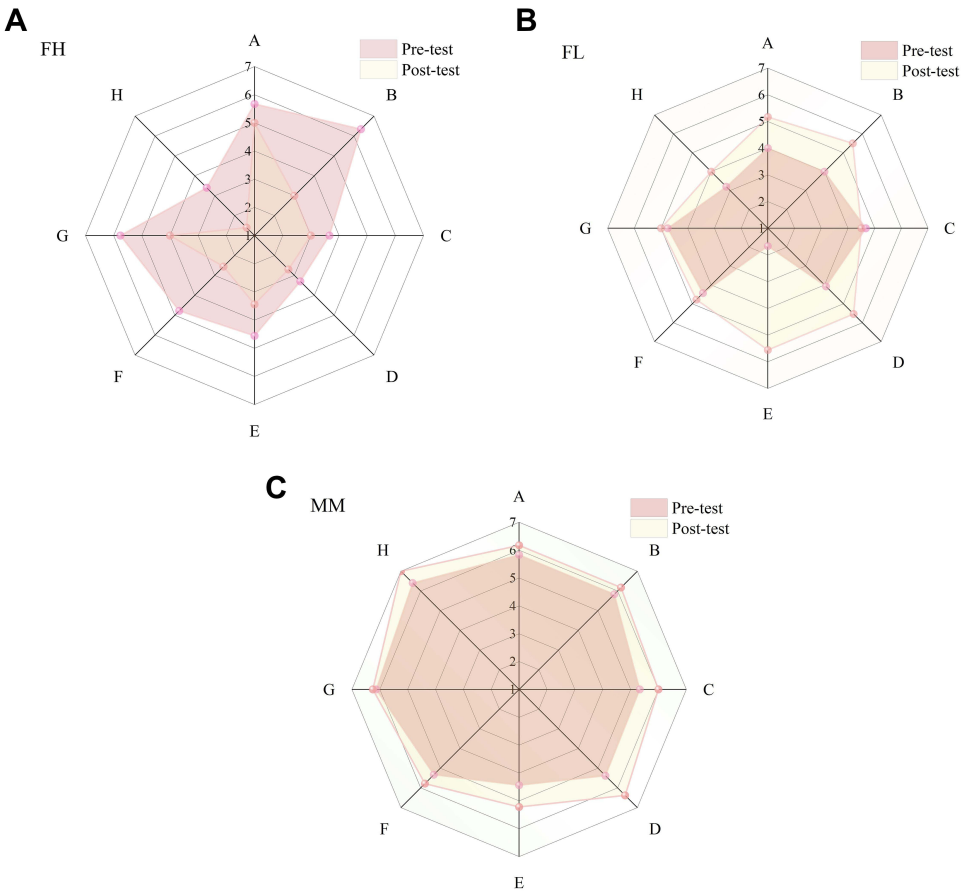

Figure 3 (**A**) Radar chart of three students FH's mathematics self-efficacy across 8 dimensions. (**B**) Radar chart of three students FL's mathematics self-efficacy across 8 dimensions. (**C**) Radar chart of three students MM's mathematics self-efficacy across 8 dimensions.
Abbreviations: A, Number and Algebra; B, Graphics and Geometry; C, Synthesis and Practice; D, Lack of interest in and fear of mathematics; E, Relative competence in mathematics; F, Self-confidence and competence in mathematics; G, Interest in, effort in, and perception of the importance of mathematics; H, Mathematics anxiety.

pretest. The changes of self-efficacy in the 8 dimensions were as followed: A(Number and Algebra), C(Synthesis and Practice), and D(Lack of interest in and fear of mathematics) dimensions decreased by no more than 1 unit, and E (Relative competence in mathematics), G(Interest in, effort in, and perception of the importance of mathematics) dimensions decreased by more than 1 unit, dimensions F(Self-confidence and competence in mathematics) and H (mathematics anxiety) decreased by more than 2 units, and dimension B(Graphics and Geometry) decreased by more than 3 units.

As shown in Figure 3B, except for dimension C decreased by no more than 1 unit, the FL's self-efficacy in math was noticeably higher in the posttest than it was in the pretest. The changes of mathematics self-efficacy in 8 dimensions were as follows: Dimensions F, G, and H have increased by no more than 1 unit, dimensions A, B, and D have increased by more than 1 unit, and dimensions E has increased by about 4 units. As shown in Figure 3C, in each dimension of the posttest, MM had a much greater degree of mathematics self-efficacy than on the pretest. The following 8 dimensions experienced such shifts in self-efficacy: A, B, C, E, F, G, and H dimensions increased by no more than 1 unit, and D dimension increased by more than 1 unit. Overall, the mathematics self-efficacy in FL and MM was almost considerably higher, whereas the level in FH was reduced.

The Level of Student's Mathematics Self-Efficacy in Wright Map

Rasch model calibrates the individual and the subject on the same single-dimensional scale through logarithmic transformation,[34] which is measured uniformly by a common scale (ie, logits). Figures 4 and 5 present the difficulty

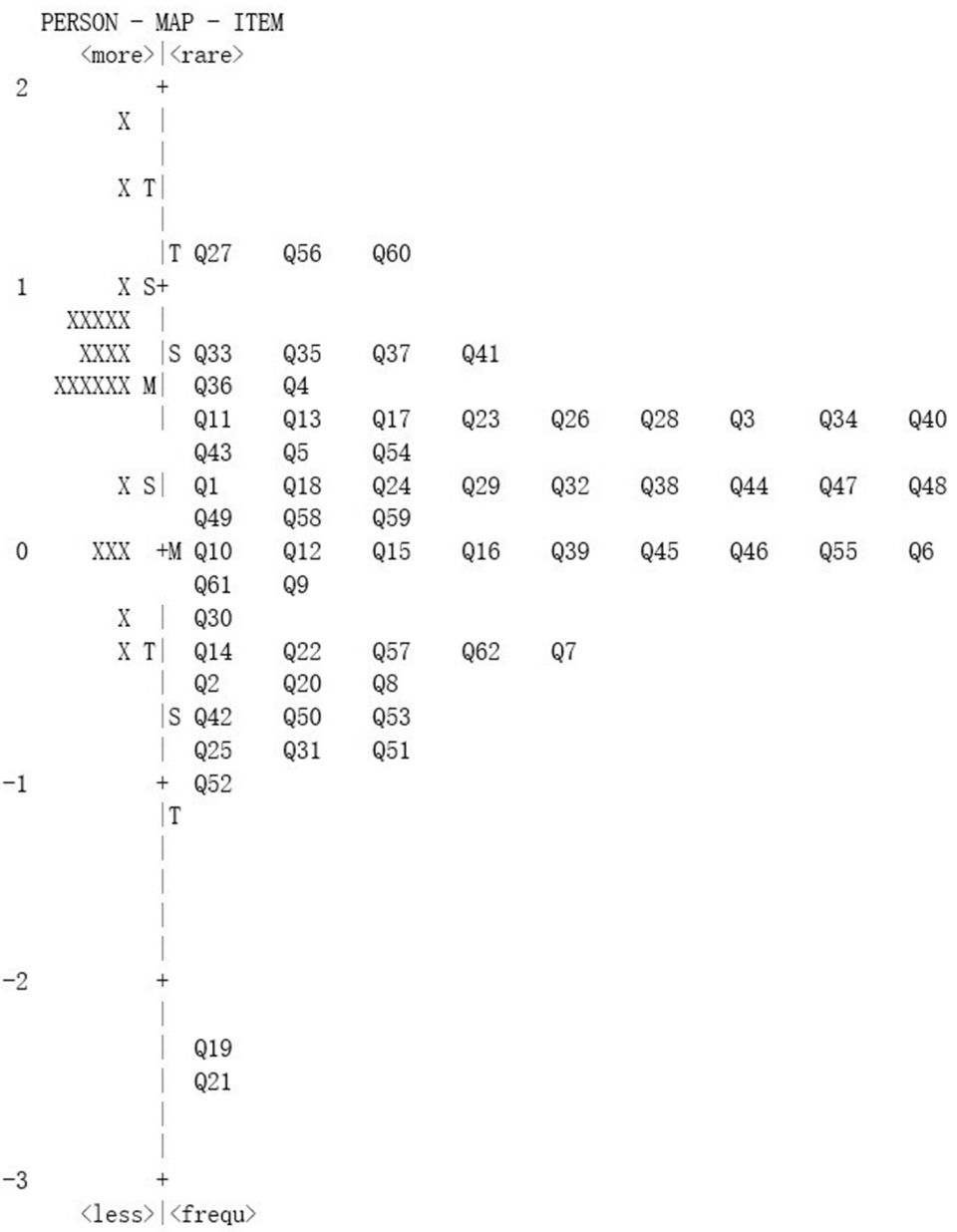

Figure 4 Wright Map of 62 items during 8 interventions.

of the item and distribution of persons' ability, respectively, which are called Person-Map-Item and Item-Map-Person. The distribution of person's ability (on the left) and item's difficulty (on the right) on the Rasch scale continuum was shown in the Person-Map-Item (Figure 4). In theory, the items at the scale's easier end (with negative logits values) are the unanimous response of most students, while items at the most difficult end of the scale (with positive logits values) are most likely among those students who perform well in math and whose mathematics self-efficacy can achieve consistency.

Figure 5 is similar to Figure 4, ie, the scale's locations for the individuals' ability and item difficulty changed. The item's degree of difficulty varies between −2.4 logits and +1.2 logits, and student measurements range from −0.2 logits to +2.0 logits. The distribution interval of item difficulty is spread over about 3.6 logits, and the distribution interval of person ability is spread over about 2.2 logits, which shows that the difficulty of the item nearly covers the abilities of all students, and that precise estimates can be made. Chan and Subramaniam[46] concluded that Wright map makes it easier to

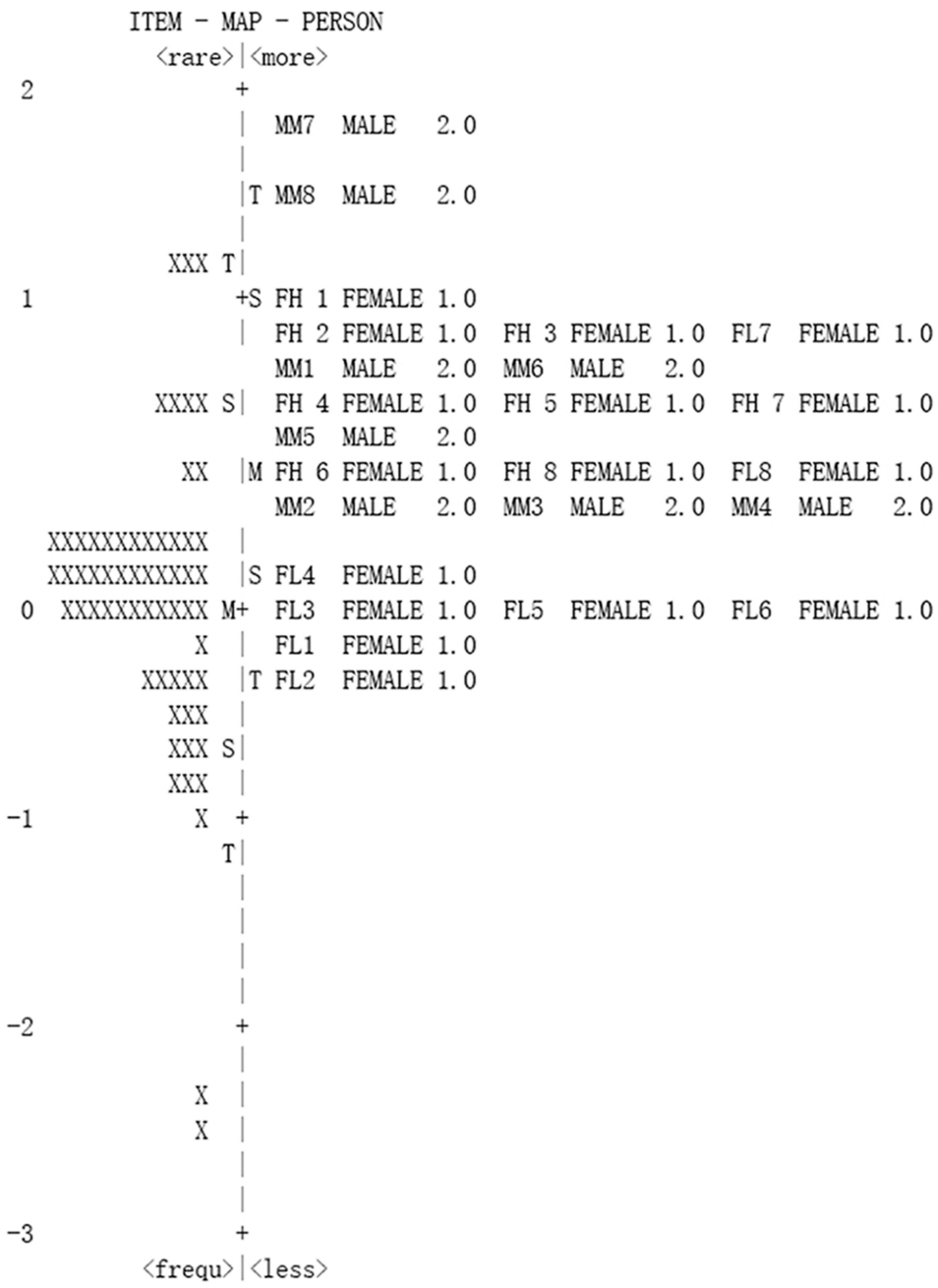

Figure 5 Wright Map for 3 students FH FL MM during 8 interventions.

evaluate construct validity since it shows how well the material on which the test is based on corresponds to the theory it is intended to predict. Therefore, construct validity is effective and good.

Figure 4 shows the distribution of the 62 items. Each "X" represents a person and the 62 items of MSLQ self-efficacy and DSMSQ on a standard scale. The item difficulty is arranged vertically from the most difficult to the easiest (ranging from +1.2 logits to −2.4 logits) and the 62 items are arranged from the top (Q27, Q56, Q60) to the bottom (Q21) of the student's mathematics self-efficacy. Q27 (When the teacher calls on me in class to answer a math question or solve a math problem, I worry that I will do poorly), Q56 (I believe I could be a mathematician or scientist when I grow up), and Q60 (My mind goes blank and I am unable to think clearly when doing mathematics) are positive answers from kids that have high self-efficacy in their math, which shows that the 3 items are challenging for all students during the 8

intervention periods. Almost all students agreed with the answers in Q21 (Mathematics is boring), indicating that the item is easy for 3 students in 8 sessions.

Figure 5 shows the distribution of 3 people, with each "X" representing an item. Their abilities are arranged vertically from the most capable to the least capable (ranging from +2.0 logits to −0.2 logits). In general, the ability of MM (+2.0 logits) is highest at the 7th intervention, while the ability of FL (−0.2 logits) is lowest at the 2nd intervention. That is to say, for three students during the 8th intervention, MM's mathematics self-efficacy is highest in the 7th intervention, while FL has the lowest self-efficacy in math during the 2nd intervention.

FH's ability (with the range from +0.6 to +1 logits) was at +1.0 logits at the first intervention, and by the 8th intervention, it had decreased by 0.4 logits to be at +0.6 logits, which demonstrates a decline in FH's degree of mathematics self-efficacy. FL's ability (with the range from −0.2 to +1.0 logits) was at +0 logits at the first intervention, while her ability was at +0.6 logits at the 8th intervention, with an increase of 0.6 logits, and it can be said that FL's self-efficacy in math has increased to some degree. MM's ability (with the range from +0.6 to +2 logits) was at +1.0 logits at the first intervention, and by the 8th intervention, it had increased by 0.6 logits to be at +1.6 logits, and increased mathematics self-efficacy in MM can be obtained. Overall, similar to the findings from Radar chart, mathematics self-efficacy in FH decreased, whereas it increased in FL and MM.

The Level of Student's Mathematics Self-Efficacy in Line Chart

There are 5 mathematical problems for each session. Table 2 displays a Three-line diagram of the average self-efficacy score in math for the three pupils throughout eight interventions, viewed as the performance of mathematics self-efficacy for each student. Figure 6 shows line chart of the average self-efficacy score in math among pupils.

As shown in Table 2, The averaging score of FH (with a range from 54 to 78) on the mathematics self-efficacy reached 72 in the prior test and 60 in the follow-up test. Figure 6 below depicts the changing trend of FH on the average score of mathematics self-efficacy: Increased - Decreased - Increased - Decreased - Increased - Decreased, while it reached the peak at the 2nd session. The FL's average score (with a range of 54 to 82) on the student's mathematics self-efficacy achieved 68 on both the beginning test and the following test.

The change trends of FL in mathematics self-efficacy average scores are shown in Figure 6 below: Increased - Decreased - Increased - Decreased - Unchanged - Increased, it also reached the peak at the 2nd session. The average score of MM (with a range of 60 to 88) on the student's self-efficacy was 72 on the pre-test and 70 on the post-test. The MM's change trends in mathematics self-efficacy average scores are shown in Figure 6 below: Increased - Decreased - Increased - Decreased - Unchanged - Increased, it also reached the peak at the 2nd intervention. In general, all students' mathematics self-efficacy has decreased at different levels based on average scores.

Discussion

The study seeks to track varieties in students' self-efficacy in math before as well as after SFBT intervention. The differences in mathematics self-efficacy measured by the MSLQ and DSMSQ among the three students are noteworthy. There is a big difference in self-efficacy in math between FH and the other students. Radar chart and Wright map of the three students' self-efficacy in math showed that the levels of FL and MM were prominently improved, while the levels of FH were markedly modified, not improved but declined. The main reason is that FH's attitude towards math is arrogant, so SFBT intervention failed to improve her mathematics self-efficacy.

In addition, the aim of SFBT intervention is to improve students' mathematical cognition to a normal level, which cannot be too high or too low. SFBT intervention is not only used to boost the confidence of students who lack

Table 2 Average Scores of Mathematics Self-Efficacy for Three Students FH FL MM per Session

	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
FH	72	78	68	54	74	66	68	60
FL	68	82	66	54	74	66	66	68
MM	72	88	68	60	80	68	68	70

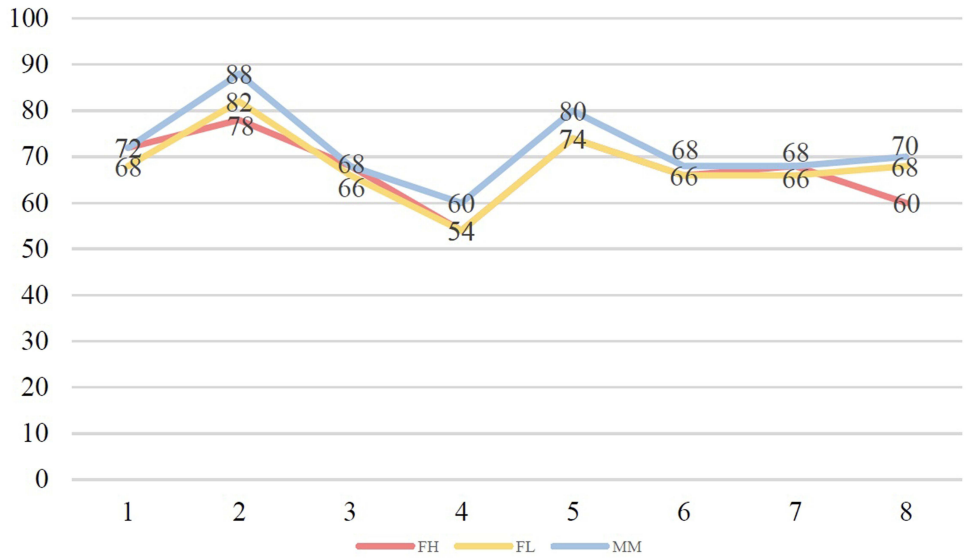

Figure 6 Average score of mathematics self-efficacy for students FH FL MM per session.

confidence in mathematics, but it can also improve the confidence of math-overconfident kids. This point of view should be actively disseminated to all front-line teachers and educational researchers.

Line chart, which primarily based its representation of the students' self-efficacy level on the measurement of their capacity to solve a particular mathematical problem, was utilized. Firstly, it was found that self-efficacy on specific mathematical problems shows a downward trend, mainly for the following reason: the important role of problem-solving questions in SFBT intervention, namely, these mathematical problems in the three fields. The difficulty of the math problems may have increased over the course of the 8 interventions, which may be responsible for the decline in students' confidence in math problems. The results of this section often do not correctly reflect the overall decline in students' self-efficacy in math.

Secondly, during 8 interventions with three students, their belief in their capacity to tackle mathematical difficulties may have increased following the first intervention, which may be why their self-efficacy peaked at the second intervention overall. It's also possible that the second session's math problems were too easy, which increased pupils' self-efficacy in their capacity to solve math problems. In summary, students' mathematics self-efficacy increased after 8 interventions.

In the present study, to verify if Rasch model could gauge variations in students' self-efficacy in math, which MSLQ self-efficacy and DSMSQ were employed to represent the pupils' degree of mathematics self-efficacy. Lee et al[39] called on researchers to use contemporary, cutting-edge psychometric techniques (such as IRT or Rasch model) to measure the psychological traits of MSLQ self-efficacy. Therefore, Rasch model may be utilized to evaluate pupils' self-efficacy theoretically. Nielsen et al[37] and Lamb et al[47] used Rasch model to measure self-efficacy. This study validates their research and proves that Rasch model can also effectively measure mathematics self-efficacy.

When the distribution of items difficulty and person's ability in Wright map was analyzed, the results show that item difficulty distribution are relatively more evenly distributed than individual ability, indicating the need for more students to better distinguish between different mathematics self-efficacy items. Some tasks are extremely simple, and the difficulty of the items does not match the individual's aptitude. Overall, it almost matches the individual's ability level. Therefore, it should be appropriate to add some challenging items, and some questions about the same difficulty should be deleted. Rasch model has been shown to be a useful tool for gauging changes in students' mathematics self-efficacy.

The research aims to evaluate the availability of SFBT intervention for improving pupils' self-efficacy in math. The mathematical instruction intervention and SFBT intervention were the two components of SFBT intervention. These results suggest that FL and MM's mathematics self-efficacy on most dimensions of the two scales have been improved to

varying degrees after the intervention while all students showed a decrease in their mathematics self-efficacy in measuring specific problems, which partially supports the effectiveness of SFBT intervention on improving mathematics self-efficacy.

The effectiveness of SFBT as an intervention strategy is currently supported by several studies in a variety of fields. Newsome[44] found that group members who got SFBT improved their cumulative GPA between the pre-intervention and post-intervention time. Using SFBT to assess alternative schools' efficacy, Franklin et al[15] discovered that the experimental group's students obtained noticeably more credits than those in the control group. This study was different in that it used SFBT intervention to affect students' mathematics self-efficacy rather than academic performance. It was found that mathematics self-efficacy of three students improved to varying degrees in certain areas, while also indirectly agreeing with their findings.

More importantly, some scholars specifically use SFBT intervention to study the changes in students' self-efficacy. Sarvi and Ghazi[18] found that using SFBT intervention can improve the self-efficacy of fifth-grade female students. Hendar et al[48] verified that the SFBT consultation group can effectively improve the self-efficacy of students in the experimental group. The study also supports the above research conclusions, and further found that students' subject self-efficacy-mathematics self-efficacy also significantly increased through SFBT intervention.

Furthermore, it is considered reasonable that psychological interventions alone may not be effective in improving students' mathematics self-efficacy and should be combined with the disciplinary knowledge intervention to availably improve the psychological characteristics of certain disciplines in school settings. In essence, it is also an organic combination of psychology and pedagogy. This study generally supports SFBT intervention as a valuable instrument for improving students' mathematics self-efficacy in educational contexts.

During the SFBT interventions, the experimenter often praises and encourages the clients. After students completed the SFBT intervention and teaching intervention, they actively provided objective feedback and unexpectedly discovered that they both liked the miracle questions and the scaling questions. During the intervention, the role of miracle questions and scaling questions is to help students experience the feeling of trying to achieve their goals and enhance their confidence, which essentially help individuals create problem-free future so that they can recognize their own strengths and help change.

On the one hand, in the miracle question, FH thought her math teacher would say, do better next time, keep on working! FL thought her math teacher would ask her about how she got rid of these bad habits, congratulate her, hope she can keep up her efforts, and tell her not to be too proud or impatient. MM thought his math teacher would be praising him, commend him, and be proud of him. All three students have already imagined their teacher's attitude towards their success in the miracle questions, which can help students improve their psychological cognition and better overcome learning difficulties.

On the other hand, in the scaling question, after the three students determined the learning level they wanted to reach, each student proposed their own way to achieve this improvement. FH recognized that she had a high error rate in solving math questions, and she needed to practice seriously and for a long time to get rid of her sloppy habit. FL recognized that she was too slow at solving math problems because her basic knowledge of math had not been acquired solidly, and she should copy and remember those math concepts and consolidate them. MM recognized that he was easily affected by the external environment and should get rid of bad habits. In general, these scaling questions can assist pupils in better recognizing their problems in mathematics.

All in all, whether it was a miracle question or a scaling question, it was beneficial for students to unlock the successful situation and recognize their problems in learning. These questions are important components of SFBT intervention, and the benefits for students in all aspects are obvious, which also proves the effectiveness of SFBT intervention. Future research can use SFBT interventions to improve self-concept and self-monitor in specific educational environments.

Implication

The study used SFBT for individual intervention to improve students' mathematics self-efficacy, which provides practical significance for intervention in the field of education. The purpose of SFBT intervention is to help students better

understand their feelings and realize their potential, and its role is significant in the educational and mental health environment. At the same time, the intervention is equally applicable to group therapy and may be useful for social workers working in educational settings with adolescents that are prone to poor performance and absenteeism.[44]

CBPR (Community-Based Participatory Research) is one of group interventions, which is a key component of psychological and public health intervention strategies conducted in collaboration with communities and partners to identify problems or available resources to improve quality of life.[49] In experimental research, Dari et al[50] used Rasch analysis to evaluate the psychometric properties of scores on the CBPR Knowledge Self-Assessment Scale (CBPR-KSAS). For low-performing students, Dari et al[51] provided a conceptual framework to illustrate the role of culturally responsive group work in promoting the development of career goals for students, especially marginalized youth. Future researchers can use community-based approaches and proactive actions to achieve more informed research and services. Whether it is SFBT intervention or CBPR, they are all designed to help people improve their psychological characteristics and better develop their overall qualities.

The present study used quantitative methods mostly, and it would be better if qualitative and quantitative methods were combined. OPV (Online Photovoice) is one of the latest and most effective innovative qualitative research methods, which provides participants with the opportunity to express their experiences with as few operations as possible.[49] It is highly recommended to use OPV to measure students' psychological traits.

Many researchers use OPV for their studies. Such as, Doyumgaç et al[49] understood the most important promoters and participants of online or distance education during COVID-19 from the unique perspective of college students, academics, and teachers through OPV. Tanhan and Strack[52] aimed to examine the biopsychosocial spiritual strengths and concerns of 118 Muslim college students living in the southeastern United States through OPV, which has important implications for addressing the biopsychosocial spiritual concerns and well-being of Muslims. Future scholars can use qualitative research or mixed methods to observe the effectiveness of OPV, while educators can also use OPV to conduct activities to enhance organizational collaboration. The quantitative method, the qualitative method, the combination of quantitative and the qualitative method have the same existential meaning, it is important to understand the psychological situation of human beings, and to achieve the reaction after that, and when to use intervention strategies to improve.

Limitations and Future Research

This study has some shortcomings. Firstly, the present study used online interaction because COVID-19 was spreading seriously at that stage. Future research can use a combination of offline research and online research to pay more attention to the research situation, which is more effective for evaluating SFBT interventions.

Secondly, due to some irresistible factors, only one month was applied for the study's duration, and there was no follow-up investigation. It would be preferable to lengthen the intervention period to make it more representative. At the same time, a follow-up survey could track how students' self-efficacy evolved in the weeks after the session and better capture how they maintained their mathematics self-efficacy. Additionally, the intervention cycle can be adjusted for primary school, middle school or high school, such as the connection from higher primary school to senior middle school.

Finally, the respondents in this study are in excessively similar basic circumstances, they are all individuals of the same age in the same class, grade, and school, which may not be as representative. Arranging the participants into groups based on their ages, backgrounds, and races may be more appropriate, which is consistent with Newsome's[44] perspective. To be able to effectively improve academic self-efficacy, practitioners should collaborate with parents, instructors, and other external forces to control some of their negative effects. Of course, these are just some hypotheses from the authors. These specific studies of using SFBT intervention to improve students' poor psychological traits require further investigation.

Conclusions

In conclusion, For the changes of students' mathematics self-efficacy after SFBT intervention, the results found that mathematics self-efficacy increased in FL and MM after SFBT, whereas mathematics self-efficacy decreased in FH. All three students showed a downward trend in self-efficacy on specific mathematical problems after intervention. Research

findings also support Rasch model can gauge the variations of students' mathematics self-efficacy. In addition, the above research results show that SFBT intervention for improving pupils' self-efficacy in math is partially effective. Although the SFBT intervention had different effects on math self-efficacy among the three pupils in the study, overall, the intervention effects were positive. The SFBT intervention remains worthy of promotion in wider educational settings. Currently, there is limited literature on interventions for mathematics self-efficacy, and future research should develop more intervention methods and tools to help students' psychological traits. Furthermore, the findings support the ability of Rasch model to visualize the effects of SFBT intervention on psychological properties in educational settings, which is of great importance.

Data Sharing Statement

The data for this study can be obtained from corresponding author according to reasonable request.

Ethics Statement

All authors confirm that this study complies with the principles outlined in the Declaration of Helsinki. The study involving human participants has been reviewed and approved by the Human Ethics Committee of Shandong Normal University. All participants in this study and their parents provided written informed consent for their individual details to be published and they fully understood the purpose and use of the study.

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Disclosure

All authors declare that they have no conflicts of interest/competing interests for this work.

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