TEACHER EDUCATION

Beyond the Wrong Answer: How Trainee Teachers Interpret, Expect, and Respond to Mathematics Learning Difficulties

Geeta Pathak

Guru Ram Dass College of Education, Guru Gobind Singh Indraprastha University (GGSIPU), Delhi, India

Published November 2026

Abstract

The study examined how Mathematics pedagogy trainee teachers identified, interpreted, and responded to students experiencing mathematics learning difficulties, with particular emphasis on the relationship between assessment evidence and teacher cognition. An assessment-based, sequential design was adopted with 21 Mathematics trainee teachers and Class VII students drawn from five schools. In Phase I, existing school-based mathematics achievement records, a researcher-developed Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT), classroom observations, and mathematical work samples were used to examine students' achievement patterns, conceptual difficulties, and recurring errors. Triangulation of these sources resulted in the identification of 63 focal students showing converging indicators of mathematics learning difficulties. In Phase II, evidence-based learner profiles were presented to the trainee teachers, who responded to the Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS). In Phase III, the Assessment-to-Action Mathematics (A2A-Math) intervention was implemented through the cycle of Assess–Analyse–Attribute–Act–Reassess. Findings indicated that students' difficulties were more clearly understood when achievement, diagnostic, observational, and work-sample evidence were considered together. Trainee teachers attributed difficulties more frequently to conceptual misunderstanding and weak prerequisite knowledge than to limited mathematical ability, although learner-related attributions were also observed. Achievement expectations were generally positive, and supportive and differentiated instructional responses received relatively high endorsement. Positive associations were observed among evidence-sensitive attributions, achievement expectations, and intended instructional responses. The study highlighted the value of linking assessment evidence with teacher interpretation and instructional decision-making and suggested that A2A-Math provided a promising framework for strengthening assessment-responsive practices in mathematics teacher education.

Keywords: achievement expectations; assessment-informed instruction; error analysis; mathematics learning difficulties; teacher attribution; trainee teachers

1 Introduction

A mathematics classroom is not simply a place where students demonstrate what they know and teachers record what they can or cannot do. It is also a setting in which teachers continually interpret learners' responses: an incorrect answer may be read as a conceptual misunderstanding, inadequate practice, lack of attention, low motivation, or limited mathematical ability. These interpretations matter because the same observable difficulty can invite very different instructional responses. Research on teacher attribution has long indicated that teachers draw on multiple explanations when interpreting students' academic success and failure, and that these explanations can be associated with the kinds of feedback and responses teachers provide (Cooper and Burger, 1989). More recent

work has similarly shown that teachers' causal beliefs concerning students with specific learning difficulties are related to the ways in which they respond to underachievement (Woodcock et al., 2019). Importantly, attribution is therefore not merely a private belief held by the teacher; it can become part of the instructional environment experienced by the learner. In mathematics, where an incorrect solution can reveal a particular misconception, an incomplete prerequisite understanding, or a difficulty in transferring a known procedure to a new context, the quality of the teacher's interpretation becomes especially consequential. What appears initially as a simple "wrong answer" may, on closer examination, provide valuable information about how the learner is thinking.

The issue becomes more significant when the teacher is still developing professional judgement. Pre-service and trainee teachers enter classroom practice with emerging pedagogical knowledge, but their interpretations of learner difficulty are also shaped by their developing beliefs about ability, effort, motivation, and achievement. Empirical research has demonstrated that trainee teachers may differ in their attributional responses to students with learning difficulties, and that such responses can influence expectations concerning students' future performance (Levkovich et al., 2016). Teacher expectations themselves are important because they are not always perfectly aligned with students' demonstrated achievement and can become associated with subsequent learning outcomes. Longitudinal evidence, for example, has shown that inaccurate teacher expectations can predict later student achievement, including achievement in mathematics (Gentrup et al., 2020). Research specifically examining mathematics achievement has also reported a relationship between teachers' expectations and students' performance, reinforcing the importance of examining what teachers expect learners to accomplish rather than focusing exclusively on current achievement (Rubie-Davies et al., 2022). At the same time, an expectation that a struggling student will improve is meaningful only when it is accompanied by an instructional response capable of supporting that improvement. This makes the connection among attribution, expectation, and intended instructional action particularly important in teacher education. A trainee teacher who interprets a recurring fraction error as evidence of weak mathematical ability may lower the level of subsequent tasks, whereas one who interprets the same error as evidence of an incomplete understanding of equivalent fractions may be more likely to reteach the underlying concept and provide targeted opportunities for conceptual reconstruction.

Against this background, the present study examined trainee teachers' cognitive perceptions of students experiencing mathematics learning difficulties through an assessment-based and action-oriented framework. Rather than identifying difficulty from a single test score, the study brought together existing school-based mathematics achievement, a conceptual and error-diagnostic assessment, classroom observation, and mathematical work samples to build a more evidence-informed picture of learners' difficulties. This evidence was then used to examine how Mathematics pedagogy trainee teachers attributed the sources of difficulty, what they expected students to achieve, and what instructional responses they intended to employ. The study subsequently introduced the Assessment-to-Action Mathematics (A2A-Math) framework, organised around the cycle Assess–Analyse–Attribute–Act–Reassess, to connect assessment evidence with instructional decision-making. This approach responded to an important practical concern in teacher preparation: trainee teachers need opportunities not only to recognise that a learner is struggling, but also to understand *what the learner is struggling with, why the difficulty may be occurring, what can reasonably be expected, and what instructional action is justified by the evidence*. The study therefore sought to move the discussion from identifying "weak" mathematics learners toward understanding the cognitive processes through which trainee teachers interpret mathematical difficulty and translate those interpretations into

expectations and intended classroom action. In doing so, it positioned assessment not as an endpoint for assigning achievement levels, but as a starting point for more informed teacher judgement and responsive mathematics instruction.

2 Related literature review

Research on teacher cognition has increasingly demonstrated that teachers' interpretations of students' performance are consequential for classroom learning. Longitudinal evidence has shown that teacher expectations can predict subsequent achievement even after students' prior achievement and background characteristics are considered (Gentrup et al., 2020). Similarly, Denessen et al. (2020) found that teacher expectations were associated with differential teacher–student interactions in mathematics classrooms, suggesting that expectations can become visible through everyday instructional exchanges. Research has also shown that teacher expectations are neither entirely fixed nor entirely accurate. Timmermans et al. (2021), examining 2,536 students and 89 teachers, reported strong stability in teachers' relative rankings of students but also found that expectations changed over time in response to students' achievement. In mathematics specifically, teachers' expectations have been associated with students' later achievement and motivational development (Gutiérrez et al., 2022; Hollenstein et al., 2024). Gentrup et al. (2020) further showed that inaccurately high expectations could be associated with improved achievement, whereas inaccurately low expectations could be detrimental. These findings suggest that examining expectations independently of the evidence available to teachers provides only a partial understanding of teacher cognition.

A parallel body of research has examined teachers' beliefs about mathematics, students' mathematical ability, assessment, and responses to mathematical errors. Studies of pre-service mathematics teachers have shown that beliefs are associated with preferred instructional practices and approaches to assessment (Tamba et al., 2021; Wellberg, 2025). Herppich and Wittwer (2018) demonstrated that pre-service teachers' beliefs about the structure of students' mathematical knowledge influenced how they approached formative assessment, highlighting the importance of teachers' interpretations of learners' conceptual and procedural knowledge. Attribution research provides another important dimension. A systematic review of 79 studies concluded that teachers' causal explanations of student performance are related to their emotions, cognitions, instructional behaviour, and student outcomes (Woodcock et al., 2018). Recent mathematics-specific evidence has continued to show that teachers may attribute mathematical struggle to a combination of personal, social, educational, and ability-related factors (Öcal et al., 2025). Indian research also points to the importance of teacher cognition. Gupta and Hussain (2018) found that pre-service teachers' beliefs about the nature of mathematics and mathematics teaching required deliberate opportunities for reflection during teacher preparation. Patnaik and Subban (2023), working with 535 primary teachers in West Bengal, showed that teachers' causal attributions for challenging classroom behaviour were connected with the strategies they proposed. Rakshit and Sahoo (2023) further demonstrated that stereotypical beliefs among Indian mathematics teachers were associated with gender gaps in students' mathematics and non-cognitive outcomes. More recent Indian evidence has shown that teachers' conceptions of inclusion can influence their classroom responses to students with diverse learning needs (Nanda and Behera, 2023).

Despite this substantial literature, an important gap remains. Much of the existing research has examined teacher expectations, teacher beliefs, attributions, or instructional practices as relatively

separate constructs. Even when relationships among them have been investigated, teacher judgments have commonly been studied through general questionnaires, ratings, or achievement data rather than through a systematic comparison between teachers' interpretations and multiple forms of direct evidence about an individual learner's mathematical difficulty. Mathematics-specific studies have also tended to focus on achievement expectations, gender or socioeconomic bias, or broad beliefs about mathematics, rather than on how trainee teachers interpret recurring conceptual errors and translate those interpretations into intended instructional action. Moreover, relatively little attention has been given to the transition from *identifying that a learner is struggling* to understanding *what the learner is struggling with, why the difficulty may have occurred, what level of achievement remains realistically possible, and which instructional response follows from that interpretation*. The present study addressed this gap by triangulating school-based achievement, conceptual/error-diagnostic assessment, classroom observation, and mathematical work samples before examining trainee teachers' attributions, achievement expectations, and intended instructional responses. It further extended the literature by testing the Assessment-to-Action Mathematics (A2A-Math) framework, thereby connecting assessment evidence with teacher cognition and subsequent instructional decision-making rather than treating these as independent aspects of mathematics teacher education.

3 Justification of the study

The rationale for the present study emerged not only from the identified gaps in research on teacher cognition but also from a recurring concern observed by the researcher while supervising trainee teachers during their school internship. In Mathematics classrooms, trainee teachers could often identify students who were "weak" or "slow," yet their judgments did not always appear to be grounded in systematic evidence about the nature of the students' mathematical difficulties. Similar errors were sometimes interpreted differently by different trainees—one attributing them to inadequate practice or effort, another to limited ability, while another recognized an underlying conceptual misunderstanding. These differences were consequential because the explanation attached to a difficulty often appeared to influence what the trainee expected the learner to achieve and the kind of instructional support considered appropriate.

This practice-based observation pointed to a significant research problem. Existing literature has examined teacher attributions, achievement expectations, and instructional practices, but these constructs have less often been examined as an interconnected process grounded in multiple sources of evidence about individual students' mathematical learning. The present study therefore first examined whether trainee teachers' identification of mathematics learning difficulties corresponded with students' school-based achievement, diagnostic assessment, classroom observation, and recurring mathematical error patterns. It then investigated the attributions trainees made and whether these were associated with their expectations of students' future mathematics achievement. A further concern arising from internship supervision was whether what trainees believed about a learner was actually reflected in the instructional responses they intended to provide.

To address this concern constructively, the study introduced Assessment-to-Action Mathematics (A2A-Math), through which trainees were guided to *Assess, Analyse, Attribute, Act,* and *Reassess*. Thus, the study moved beyond documenting trainee teachers' perceptions to examining whether an evidence-informed intervention could strengthen their attributions, achievement expectations, instructional responses, and, ultimately, students' mathematics performance.

4 Research questions

1. To what extent do trainee teachers' identification of mathematics learning difficulties align with students' achievement, diagnostic, observation, and error-pattern evidence?
2. What attributions do trainee teachers make about students' mathematics learning difficulties, and how are these related to their achievement expectations?
3. How are trainee teachers' attributions and achievement expectations associated with their intended instructional responses?
4. What effect does the A2A-Math intervention have on trainee teachers' attributions, achievement expectations, instructional responses, and students' mathematics performance?

5 Methodology

The study adopted an assessment-based, mixed-method, quasi-experimental design to examine how Mathematics trainee teachers perceived, interpreted, and responded to students experiencing mathematics learning difficulties. The study was conducted during the teaching internship of 21 Mathematics pedagogy trainee teachers across five schools, comprising three private and two government schools. The investigation was organized into three sequential phases:

- In the first phase, Class VII students were examined through multiple sources of mathematics learning evidence. Existing school-based academic achievement records, including relevant unit and class-test performance, were reviewed to identify patterns of mathematical performance. Students were subsequently administered the Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT) to identify specific areas of conceptual difficulty, procedural errors, and recurring misconceptions. Classroom observations were conducted across relevant Mathematics lessons to examine students' task engagement, problem-solving behaviour, response to instructional support, and persistence of observed difficulties. Mathematical work samples were also analysed to identify recurring error patterns and provide further insight into students' mathematical thinking. These sources were triangulated to identify 63 focal students showing converging evidence of persistent mathematics learning difficulties. Importantly, the study did not treat low achievement or diagnostic-test performance as evidence of a learning disability; rather, the findings were interpreted as indicators of mathematics learning difficulties within the context of classroom learning.
- The second phase focused on the cognitive judgments of the 21 Mathematics pedagogy trainee teachers. Evidence-based learner profiles were prepared from the assessment, observation, achievement, and mathematical work-sample data generated in Phase I. The trainee teachers examined these profiles and responded to the Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS). This phase examined how trainee teachers explained the observed mathematics learning difficulties, the level of achievement they expected from the learners, and the instructional responses they considered appropriate. Particular attention was given to the correspondence between trainee teachers' judgments and the assessment evidence available for each learner.
- In the third phase, the Assessment-to-Action Mathematics (A2A-Math) intervention was implemented with the 21 trainee teachers and the 63 focal students. The intervention followed a structured Assess–Analyse–Attribute–Act–Reassess cycle. Trainee teachers first revisited the available assessment evidence, analysed students' mathematical errors and possible misconceptions, and considered plausible explanations for the observed difficulties before

selecting an instructional response. Targeted strategies were then implemented through the Mathematics Response Toolkit, including manipulatives, visual representations, mathematical games, peer explanation, art-integrated mathematical activities, differentiated tasks, and selected digital resources. Student responses and emerging learning evidence were monitored throughout the intervention. Following the intervention, students' mathematics performance and trainee teachers' cognitive judgments were reassessed to examine changes in mathematical achievement, attributions, achievement expectations, and intended instructional responses.

The three phases are summarized in Table 1.

Table 1. Three-phase structure of the study.

Phase	Focus	Major Activities	Tools / Data Sources	Key Outcome
Phase I	Assessment & Identification (≈463 Class VII students)	Reviewed existing Mathematics achievement records and unit/class-test performance; administered the Mathematics Conceptual Understanding and Error Diagnostic Test; observed students across multiple Mathematics lessons; analysed mathematical work samples and recurring error patterns; triangulated evidence across sources	Tool I: Existing School-Based Mathematics Academic Achievement Measure; Tool II: Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT); Tool III: Mathematics Learning Difficulty Observation Schedule; Mathematical Work Samples	Identification of 63 focal students showing converging evidence of persistent mathematics learning difficulties and specific conceptual/error patterns
Phase II	Cognitive Judgement (21 Mathematics pedagogy trainee teachers)	Presented evidence-based learner profiles incorporating students' assessment findings, observed classroom behaviours, achievement patterns, and mathematical errors; examined trainee teachers' explanations of students' difficulties, achievement expectations, and intended instructional responses	Tool IV: Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS); Evidence-Based Learner Profiles	Identification of trainee teachers' attribution patterns, achievement expectations, and intended instructional responses, along with the degree of correspondence between teacher judgments and assessment evidence
Phase III	Assessment-to-Action & Reassessment (21 Mathematics trainee teachers + 63 focal students)	Implemented the A2A-Math cycle: Assess → Analyse → Attribute → Act → Reassess; analysed individual mathematical errors and misconceptions; selected targeted instructional strategies; implemented differentiated mathematics activities; monitored student responses; reassessed mathematical learning and trainee-teacher judgments	A2A-Math Intervention; Mathematics Response Toolkit; targeted learner tasks; post-intervention Mathematics Assessment; post-intervention TTAEIRS; student work samples and observation evidence	Evidence of changes in students' mathematics performance, trainee teachers' attributions and achievement expectations, and their intended instructional responses following assessment-informed intervention

The three-phase design followed a deliberate progression from evidence to interpretation and finally to action. Phase I established an assessment-based understanding of students' mathematics learning

difficulties by bringing together standardized performance, classroom observation, academic achievement, and mathematical error patterns. Phase II examined how trainee teachers interpreted this evidence through their attributions, achievement expectations, and intended instructional responses. Phase III translated assessment findings into targeted instructional action through the A2A-Math intervention and subsequent reassessment. This progression enabled the study to examine not only what trainee teachers perceived, but also how evidence shaped their judgments and whether those judgments could be translated into more responsive mathematics teaching.

5.1 Sample

The study was situated within the natural context of the teaching internship, thereby allowing the researcher to examine trainee teachers' judgments and instructional decisions in authentic mathematics classrooms. The total student population comprised approximately 463 Class VII students studying Mathematics in five internship schools. The schools represented two institutional settings—three private schools and two government schools—providing variation in the academic and classroom environments within which the trainee teachers worked.

The teacher sample consisted of 21 trainee teachers enrolled in the Mathematics pedagogy programme. These trainee teachers were selected from the larger internship cohort because their teaching responsibility specifically involved Mathematics. Each trainee teacher taught Mathematics to an assigned Class VII section during the internship period and interacted with students as part of regular classroom teaching and assessment.

The approximately 463 Class VII students were initially retained as the broader assessment population rather than being identified solely on the basis of trainee teachers' perceptions of mathematics learning difficulties. This approach was adopted to minimize the possibility that initial teacher judgments would predetermine which learners were considered to be experiencing difficulties. Instead, students' mathematical functioning was examined through multiple sources of evidence, including standardized mathematics assessment, systematic classroom observation, school-based achievement records, and analysis of mathematical work and recurring error patterns. This multi-source approach provided a more grounded basis for identifying students whose difficulties appeared to be persistent rather than reflecting an isolated instance of low performance.

The sample therefore comprised two interconnected levels. The 21 Mathematics pedagogy trainee teachers constituted the teacher-level sample, while the approximately 463 Class VII students formed the initial student-level assessment population. Following the assessment and triangulation of evidence, 63 students were identified as focal students. Their selection was based on converging indicators across the assessment, observation, achievement, and mathematical error data. These students subsequently became the focus of the intensive Assessment-to-Action Mathematics (A2A-Math) intervention, enabling the study to examine whether an assessment-informed and targeted instructional approach could influence both students' mathematical performance and trainee teachers' perceptions, expectations, and instructional responses. The composition of the sample is given in Table 2.

Table 2. Sample diversification.

Sample Dimension	Category	Participants
Trainee Teachers	Mathematics Pedagogy (N=21)	Girls:boys = 17:4 Graduates:postgraduates = 16:5
Schools (5)	Private:government	3(n=258):2 (n=205)
Students	Class VII Mathematics students (N=463)	Girls:boys = 222:241
Student Role	Initial assessment population	463
	Students showing converging indicators of mathematics learning difficulties	63 focal students

5.2 Assessment-to-Action Mathematics (A2A-Math) intervention

The third phase of the study introduced the Assessment-to-Action Mathematics (A2A-Math) intervention, developed to help trainee teachers move beyond simply identifying students as "weak" in Mathematics and instead respond to the specific nature of their mathematical difficulties. The intervention was grounded in the premise that an incorrect mathematical response is not merely an error to be corrected; it can provide valuable information about how a learner is understanding, interpreting, or processing a mathematical idea. Accordingly, A2A-Math followed a five-stage cycle: Assess → Analyse → Attribute → Act → Reassess.

1. In the Assess stage, trainee teachers gathered evidence through students' classroom responses, written work, short diagnostic tasks, observation, and existing achievement records. The Analyse stage required them to look beyond the final answer and identify recurring error patterns or misconceptions. For instance, a learner who adds both numerators and denominators while operating with unlike fractions may not simply be "careless"; the response may indicate an incomplete understanding of the meaning of fractions or of the conditions under which fractions can be combined.
2. In the Attribute stage, trainee teachers considered plausible explanations for the difficulty, including conceptual misunderstanding, weak prerequisite knowledge, difficulty interpreting mathematical language, limited practice, attention to procedural steps, or task-related factors. Particular emphasis was placed on avoiding premature attribution of difficulty to low ability or lack of effort. The Act stage then translated this interpretation into a targeted instructional response. Rather than assigning the same remedial worksheet to every learner, trainee teachers selected strategies according to the identified need. These included manipulatives, mathematical games, visual representations, peer explanation, puzzles, storytelling, art-integrated tasks, movement-based activities, digital resources, collaborative problem-solving, and error-analysis activities.
3. Finally, in the Reassess stage, students attempted a parallel or conceptually similar task. The trainee teacher examined whether the original error persisted, changed, or disappeared and recorded the learner's response. This created a continuous feedback loop in which assessment informed interpretation, interpretation informed instruction, and subsequent evidence informed the next instructional decision. Thus, A2A-Math functioned not as conventional remedial teaching, but as an assessment-informed cycle of responsive mathematics instruction.

Table 3 illustrates how the A2A-Math cycle was applied to the three internship topics.

Table 3. Practical application of A2A-Math across the three internship topics.

Class VII Topic	Possible Difficulty/Error Identified	What the Error May Reveal	A2A-Math Response	Reassessment Task
Fractions & Decimals	Adds numerator and denominator separately, e.g., 1/2+1/3=2/5	Learner may not understand equivalent fractions or the meaning of a common denominator	"Fraction Market" game: learners use fraction cards or paper strips to combine quantities and find equivalent representations; connect fractions with decimals using a visual number line	Give parallel fraction-addition problems using different denominators and ask the learner to explain *why* the denominator changes
Fractions & Decimals	Confuses decimal place value, e.g., assumes 0.45 > 0.5 because 45 > 5	Weak understanding of place value rather than inability to compare numbers	Decimal Number-Line Challenge: learners physically position decimal cards on a floor/board number line; use money-based examples such as ₹0.45 and ₹0.50	Compare unfamiliar decimals and justify the answer using a number line or place-value representation
Triangles & Its Properties	Unable to identify or classify triangles correctly	Difficulty noticing defining properties such as sides/angles	"Triangle Detective" activity: learners sort and create triangles using sticks/ geometric strips, then classify them according to observable properties	Present unfamiliar triangles in different orientations and ask learners to classify and state the defining property
Triangles & Its Properties	Memorizes properties but cannot apply them to a problem	Procedural recall without conceptual transfer	Build–Break–Explain: learners construct triangles, alter one side/angle, predict what happens, and explain the resulting property; peer explanation is encouraged	Provide a new problem requiring the learner to apply the property rather than recall its definition
Perimeter & Area	Uses the area formula when perimeter is required, or vice versa	Confusion between the concepts of boundary and surface covered	"Border vs Carpet" activity: learners physically outline objects with string for perimeter and cover surfaces with square units for area	Give irregular and rectangular figures and ask learners to identify whether the task requires perimeter or area before calculating
Perimeter & Area	Believes that a larger perimeter always means a larger area	Difficulty understanding the relationship between two-dimensional measures	Same Area–Different Shape Challenge: learners create different rectangles with the same area and compare their perimeters; extend to the reverse situation	Ask learners to construct or identify shapes satisfying a specified area/ perimeter condition and explain their reasoning

5.3 Evaluation tools

5.3.1 Tool I: existing school-based academic achievement measure in mathematics

The first tool comprised the existing Class VII Mathematics Academic Achievement Tests routinely administered by the respective class teachers during the internship period. These included relevant unit tests, class tests, and other school-based assessments already used to evaluate students' mathematics learning. The researcher did not introduce a separate achievement test at this stage, as the purpose was to obtain evidence of students' performance under their normal classroom assess-

ment conditions. The primary purpose of using these existing assessments was to identify students showing relatively persistent patterns of low or inconsistent achievement in Mathematics. Scores obtained across relevant tests were examined rather than relying on a single test result. This helped distinguish an ongoing difficulty from temporary poor performance or an isolated assessment outcome. Since these were existing school-based assessments, they were not treated as standardized research instruments and their psychometric properties were not re-established by the researcher. However, the content and scoring procedures of the assessments were reviewed by six Teacher Educators with expertise in Mathematics education and educational assessment to determine their curricular relevance and suitability for the study. Relevant assessment records were compiled using a common data-recording format to ensure consistency across schools. For analysis, students' scores were examined individually and comparatively, with attention to repeated low performance, topic-wise weaknesses, and patterns across available assessments. These findings were subsequently considered alongside the researcher-developed diagnostic test and classroom-observation evidence. Thus, Tool I provided the authentic school-based achievement baseline and served as the first stage in identifying students requiring more detailed examination.

5.3.2 *Tool II: Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT)*

The second tool was a researcher-developed Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT) designed specifically for Class VII Mathematics. Unlike Tool I, which indicated *how well* students were performing, this test was developed to examine what students understood, where their conceptual difficulties occurred, and what types of mathematical errors or misconceptions they demonstrated. The test consisted primarily of multiple-choice items, with carefully constructed distractors representing common mathematical misconceptions. Content areas were selected from the Class VII Mathematics curriculum, particularly Fractions and Decimals, Triangles and their Properties, and Perimeter and Area. Items were designed to identify conceptual misunderstanding, procedural errors, weak prerequisite knowledge, and difficulties in applying mathematical concepts to unfamiliar situations.

The initial test was reviewed by six Teacher Educators for content relevance, age appropriateness, clarity, curricular alignment, and adequacy of representation of the intended mathematical concepts. Their suggestions were incorporated before pilot administration. A pilot study was subsequently conducted with students comparable to the study population. Item difficulty, discrimination, response patterns, and ambiguity were examined, and weak or unclear items were revised or removed. Internal consistency of the final test was examined using an appropriate coefficient, such as KR-20 of .84, suggesting a satisfactory level of consistency among the items in assessing students' conceptual understanding of the selected Class VII Mathematics content. Students' responses were analysed both in terms of total performance and item-level error patterns. Particular attention was given to recurring incorrect responses that indicated identifiable misconceptions. Findings from Tool II, together with Tool I and Tool III evidence, were used to identify the 63 focal students for the intervention phase.

5.3.3 *Tool III: Mathematics Learning Difficulty Observation Schedule*

The third tool was a researcher-developed Mathematics Learning Difficulty Observation Schedule designed to capture students' mathematical learning behaviour in their natural classroom environment. The schedule complemented the achievement and diagnostic assessments by providing evidence of how students approached mathematics tasks during regular instruction.

The schedule included observable indicators such as difficulty understanding mathematical instructions, recurring computational or conceptual errors, hesitation in initiating tasks, dependence on repeated prompts, difficulty explaining mathematical reasoning, slow or incomplete task completion, limited participation, persistence during problem solving, and response to teacher support. Items were deliberately framed as observable classroom behaviours rather than diagnostic labels. A four-point rating format, ranging from rarely observed to consistently observed, was used to record the frequency of these behaviours.

The initial schedule was reviewed by six Teacher Educators for relevance, clarity, observability, and alignment with the objectives of the study. Their feedback was used to remove overlapping indicators and refine ambiguous statements. The revised schedule was piloted in comparable classroom settings to examine feasibility and consistency of administration. Internal consistency was examined using Cronbach's alpha where appropriate. Cronbach's alpha of .88, indicating good internal consistency among the observation indicators. Where observations were independently rated by two observers, inter-rater reliability was also examined, yielding an intra-class correlation coefficient (ICC) of .82, indicating good agreement between observers. Observation ratings were considered alongside school-based achievement scores and responses on the MCUEDT. This triangulation helped determine whether difficulties identified through assessment were also reflected in students' classroom behaviour. Tool III therefore provided the naturalistic classroom evidence needed to strengthen the identification of the 63 focal students.

5.3.4 Tool IV: Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS)

The fourth tool was the Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS), a researcher-developed instrument designed to examine the cognitive judgments of the 21 Mathematics pedagogy trainee teachers. The scale focused on three interrelated dimensions: attribution of mathematics learning difficulties, achievement expectations, and intended instructional responses. The attribution component examined the extent to which trainee teachers associated students' difficulties with factors such as conceptual misunderstanding, inadequate prerequisite knowledge, effort, motivation, attention, limited practice, task difficulty, instructional factors, or perceived ability. The achievement-expectation component examined the level of mathematics performance trainee teachers expected from the learner following appropriate support. The instructional-response component assessed intended responses such as re-teaching, scaffolding, manipulatives, visual representations, mathematical games, peer learning, differentiated tasks, additional practice, and digital learning activities.

Rather than asking trainees to judge abstract categories such as "weak students," the scale was administered using evidence-based learner profiles developed from the assessment and observation data. This allowed the study to examine whether teacher judgments corresponded with available evidence.

The instrument was reviewed by six Teacher Educators for content relevance, clarity, construct coverage, and alignment with the research questions. It was then piloted with comparable Mathematics trainee teachers. Item analysis and internal consistency were examined for each dimension, with Cronbach's alpha and item-total correlations calculated where appropriate. The Attribution dimension yielded a Cronbach's alpha of .86, the Achievement Expectations dimension yielded .83, and the Instructional Response dimension yielded .89. Corrected item–total correlations ranged approximately from .42 to .71, indicating that the retained items demonstrated adequate relation-

ships with their respective dimension scores. The TTAEIRS was administered before and after the A2A-Math intervention, enabling examination of changes in trainee teachers' attributions, achievement expectations, and intended instructional responses.

The four evaluation tools are summarized in Table 4.

Table 4. Description of the evaluation tools.

Tool	Instrument	Type	Used With	Main Purpose
Tool I	Existing Class VII Mathematics Academic Achievement Test / Unit-Class Test	Existing school-based measure	463 students	Establish students' actual classroom achievement and identify persistent low-performance patterns
Tool II	Mathematics Conceptual Understanding & Error Diagnostic Test (MCUEDT)	Researcher-developed, MCQ-based diagnostic test	Students identified through Tool I	Identify *specific mathematical concepts, misconceptions and error patterns* rather than simply low achievement
Tool III	Mathematics Learning Difficulty Observation Schedule	Researcher-developed observation schedule	Students identified through Tools I–II	Examine whether difficulties are also visible in natural classroom behaviour
Tool IV	Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS)	Researcher-developed scale	21 trainee teachers	Examine attribution, achievement expectations and intended instructional responses

5.4 Data analysis

Data generated through the four evaluation tools were analysed sequentially and triangulated to address the research questions. In Phase I, students' scores from the existing school-based Mathematics achievement tests were compiled and examined using descriptive statistics, including mean, standard deviation, percentage scores, and performance patterns across the assessed topics. Responses to the Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT) were analysed at both the total-score and item levels. Particular attention was given to frequently occurring incorrect responses and identifiable misconception or error patterns. Observation ratings from the Mathematics Learning Difficulty Observation Schedule were summarized using item-wise and domain-wise frequencies and descriptive statistics. These findings were compared with achievement scores, diagnostic-test responses, and mathematical work samples to identify 63 focal students showing converging evidence of mathematics learning difficulties.

In Phase II, responses on the Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS) were analysed dimension-wise. Means, standard deviations, and response distributions were computed for attribution, achievement expectations, and intended instructional responses. Relationships among these dimensions were examined using appropriate correlation analysis. Trainee-teacher judgments were also compared with the assessment-based profiles of the focal students to examine perception–evidence alignment.

In Phase III, pre- and post-intervention scores were compared to examine changes following A2A-Math. Appropriate paired-sample analyses were used for trainee-teacher scale scores and students' mathematics performance, with effect sizes reported to indicate the magnitude of change. Qualitative evidence from student work, observation notes, and error patterns was used to complement the

quantitative findings. This integrated analysis enabled interpretation of the progression from assessment and identification to cognitive judgment, instructional action, and reassessment.

6 Results

6.1 Tool I: existing school-based mathematics academic achievement measure

The existing school-based Mathematics achievement records of 463 Class VII students were analysed to establish the initial pattern of mathematical performance. Scores obtained from relevant unit and class tests were converted into percentage scores and classified into three broad performance categories: high (≥70%), moderate (50–69%), and low (<50%). Descriptive statistics were also calculated for the overall achievement scores and for the major content areas represented in the available school assessments. The results are given in Table 5.

Table 5. Existing school-based mathematics achievement of the Class VII students (N = 463).

Mathematics Achievement Indicator	N	Mean (%)	SD	Students Below 50%	Students 50–69%	Students ≥70%
Overall Mathematics Achievement	463	54.82	14.37	143 (30.9%)	211 (45.6%)	109 (23.5%)
Fractions & Decimals	463	51.76	17.21	169 (36.5%)	187 (40.4%)	107 (23.1%)
Triangles & Properties	463	57.43	16.08	128 (27.6%)	217 (46.9%)	118 (25.5%)
Perimeter & Area	463	52.18	17.64	158 (34.1%)	202 (43.6%)	103 (22.2%)

The overall mean achievement score of 54.82% (SD = 14.37) indicated a moderate level of mathematical attainment across the assessed student group. However, the distribution showed considerable variation in performance. Nearly one-third of the students (30.9%) obtained scores below 50%, while only 23.5% demonstrated achievement at or above 70%. The relatively large standard deviation further suggested substantial individual differences in mathematical performance. Topic-wise analysis showed comparatively lower achievement in Fractions and Decimals (M = 51.76, SD = 17.21) and Perimeter and Area (M = 52.18, SD = 17.64) than in Triangles and Properties (M = 57.43, SD = 16.08). The comparatively larger variability in Perimeter and Area also indicated that students differed considerably in their mastery of this content.

The findings from Tool I indicate that mathematics achievement among the 463 Class VII students was moderate overall, but unevenly distributed. The overall mean of 54.82% suggests that although a substantial proportion of students were able to meet basic classroom expectations, a sizeable group experienced difficulty in demonstrating consistent mathematical achievement. The finding that 30.9% of students scored below 50% is particularly noteworthy, but it should not be interpreted as evidence that all these students experienced persistent mathematics learning difficulties. Rather, it provided an initial indication of students who warranted more detailed assessment. The topic-wise results were also informative. Fractions and Decimals recorded the lowest mean achievement, followed closely by Perimeter and Area, suggesting that these areas may require greater conceptual attention. The relatively high standard deviations across topics indicate considerable differences between learners, reinforcing the need to move beyond overall achievement scores. Importantly, Tool I answered "who may require closer examination", but could not adequately answer "what mathematical difficulty does the learner experience and why?" This limitation justified the subsequent use of

the diagnostic test, classroom observation, and mathematical work analysis. Thus, the achievement data served as the first evidential layer in the identification process. The findings established a meaningful baseline while also demonstrating why achievement scores alone were insufficient for identifying the 63 focal students. The subsequent triangulation of evidence was therefore essential for distinguishing general low achievement from more persistent and conceptually meaningful patterns of mathematics learning difficulty.

These findings were useful as an initial screening indicator rather than a basis for labelling students as having learning difficulties. In particular, the 143 students performing below 50% represented a group requiring closer examination, but low achievement alone could not establish the presence or nature of a mathematics learning difficulty. Consequently, their performance was examined further through the Mathematics Conceptual Understanding and Error Diagnostic Test (Tool II), classroom observation (Tool III), and analysis of mathematical work samples. The findings therefore provided the achievement baseline against which more specific patterns of conceptual difficulty and error could subsequently be identified.

6.2 Tool II: Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT)

The Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT) was administered to the students who showed comparatively lower or inconsistent achievement in Tool I. The purpose was not simply to reconfirm low performance, but to identify the specific conceptual areas and recurring mathematical errors underlying students' difficulties. The test comprised 30 dichotomously scored multiple-choice items covering three selected Class VII Mathematics areas: Fractions and Decimals, Triangles and their Properties, and Perimeter and Area. The distractors were designed to represent commonly observed misconceptions and procedural errors. The results are given in Table 6.

Table 6. Results of the Mathematics Conceptual Understanding and Error Diagnostic Test (MCUEDT).

Diagnostic Area	No. of Items	Mean Score	Mean %	SD	Students Below 50%	Frequently Observed Error Pattern
Fractions & Decimals	10	4.38	43.8	2.21	92 (64.3%)	Common-denominator errors; decimal place-value confusion
Triangles & Properties	10	5.46	54.6	2.34	61 (42.7%)	Misclassification; difficulty applying defining properties
Perimeter & Area	10	4.71	47.1	2.48	83 (58.0%)	Confusion between perimeter and area; inappropriate formula selection
Overall MCUEDT	30	14.55	48.5	5.74	78 (54.5%)	Conceptual and procedural errors across topics

The findings indicate that the students identified for further examination through Tool I did not experience difficulty uniformly across all mathematical content. Fractions and Decimals emerged as the most problematic area, with a mean performance of 43.8%, followed by Perimeter and Area (47.1%). Triangles and their Properties showed comparatively better performance (54.6%), although a substantial proportion of students continued to demonstrate difficulty. Item-level analysis provided more meaningful evidence than the total score alone. In Fractions and Decimals, approximately 61% of the students incorrectly treated numerators and denominators independently while adding fractions, while 54% demonstrated difficulty interpreting decimal place value. In Perimeter and Area,

approximately 57% confused the concepts of boundary length and surface coverage, and 49% selected an inappropriate formula when the problem was presented in an unfamiliar form. In the Triangles and Properties domain, 46% of students incorrectly classified triangles when their orientation or visual appearance was changed. The distractor analysis suggested that several incorrect responses were systematic rather than random. This indicated that students were often applying an alternative but internally consistent rule, pointing towards conceptual misconceptions rather than simple carelessness. For example, selecting 2/52/5 for 1/2+1/31/2 + 1/3 reflected an apparent tendency to add numerators and denominators separately. The diagnostic test therefore provided evidence that the difficulties observed through school achievement records had specific mathematical characteristics. Students' responses were subsequently compared with classroom-observation ratings and mathematical work samples. The convergence of these sources was used to identify the 63 focal students for the A2A-Math intervention.

The findings from Tool II substantially deepened the picture emerging from Tool I. While the school-based achievement data indicated that a sizeable proportion of students were performing below the expected level, the MCUEDT demonstrated that their difficulties were neither uniform nor adequately explained by overall achievement scores. The overall mean of 48.5% suggested that the students requiring closer examination experienced considerable difficulty with the conceptual understanding and application of selected Class VII mathematical ideas.

The strongest difficulty was observed in Fractions and Decimals, followed by Perimeter and Area. However, the most significant finding was the nature of the incorrect responses. Several distractors attracted substantial numbers of students, suggesting that the errors reflected recognizable patterns of mathematical thinking rather than random guessing. For instance, treating the numerator and denominator independently while adding fractions indicates a misconception about the role of equivalent fractions and common denominators. Similarly, confusion between perimeter and area suggests that some students had memorized procedures without developing a sufficiently clear conceptual distinction between the two quantities. The findings therefore shifted the interpretation from "students are low achievers" to "students are experiencing particular forms of mathematical misunderstanding." This distinction is central to the present study because A2A-Math requires trainee teachers to respond to the *nature* of an error rather than merely to the learner's score.

Tool II consequently functioned as the diagnostic layer of the identification process. However, the researcher did not use the diagnostic score alone to designate students as having mathematics learning difficulties. The evidence was further triangulated with classroom observations and mathematical work samples. This process enabled the researcher to identify the 63 focal students whose difficulties appeared sufficiently persistent and consistent across assessment contexts to warrant targeted instructional intervention.

6.3 Tool III: Mathematics Learning Difficulty Observation Schedule

The Mathematics Learning Difficulty Observation Schedule was used to examine whether the difficulties identified through school-based achievement data and the MCUEDT were also evident during regular classroom learning. Observations were conducted across multiple Mathematics lessons, allowing the researcher to distinguish persistent patterns from isolated classroom behaviours. The schedule comprised five broad domains: understanding mathematical instructions, conceptual and procedural performance, problem-solving behaviour, task engagement and completion, and response to instructional support. Each indicator was rated on a four-point scale, with higher scores

representing greater and more consistent manifestation of the observed difficulty. The results are given in Table 7.

Table 7. Results of the Mathematics Learning Difficulty Observation Schedule.

Observation Domain	No. of Indicators	Mean	SD	Students Frequently/Consistently Showing Difficulty	% of Observed Students
Understanding Mathematical Instructions	5	2.71	0.68	96	67.1%
Conceptual & Procedural Performance	7	2.94	0.71	112	78.3%
Problem-Solving & Mathematical Reasoning	5	2.82	0.73	103	72.0%
Task Engagement & Completion	4	2.54	0.69	81	56.6%
Response to Instructional Support	4	2.38	0.64	74	51.7%
Overall Observation Schedule	25	2.68	0.57	98	68.5%

The findings indicate that conceptual and procedural performance represented the most prominent area of observed difficulty, with a mean rating of 2.94 (SD = 0.71). This was followed by problem-solving and mathematical reasoning (M = 2.82, SD = 0.73) and difficulty in understanding mathematical instructions (M = 2.71, SD = 0.68). Comparatively lower ratings were observed for task engagement and completion and response to instructional support, although these areas continued to be evident among a substantial proportion of students. The observation data were further examined against the findings from Tools I and II. Among students who had demonstrated repeated conceptual errors in the MCUEDT, 81.4% also displayed corresponding difficulties during classroom Mathematics activities. Similarly, students with recurring achievement difficulties in Tool I were more frequently observed requiring repeated prompts, additional explanation, or extended time to complete mathematical tasks. The convergence across the three sources was particularly important for focal-student identification. Rather than applying a single numerical cut-off, students were considered for focal status when low or inconsistent school achievement, identifiable mathematical misconceptions/errors, and persistent classroom indicators occurred together. On this basis, 63 students demonstrated sufficiently consistent evidence across the assessment and observation data to be retained as focal students for the A2A-Math intervention.

The observation findings therefore strengthened the ecological validity of the identification process by demonstrating that the mathematical difficulties reflected in assessment responses were also manifested in students' actual classroom learning behaviour.

The findings of Tool III provide an important classroom-based confirmation of the patterns identified through the first two tools. The overall observation Mean of 2.68 indicates that mathematics-related learning difficulties were visible with reasonable consistency during regular classroom interaction. The highest mean was recorded for conceptual and procedural performance (M = 2.94), which corresponds closely with the conceptual and procedural errors identified through the MCUEDT. This convergence strengthens the interpretation that many of the observed difficulties were not simply products of test-taking conditions. Problem-solving and mathematical reasoning also emerged as an

important area of difficulty. Students were frequently observed hesitating when faced with unfamiliar problems, relying on repeated teacher prompts, or finding it difficult to explain the reasoning behind a procedure they had applied. Interestingly, task engagement and response to support received comparatively lower mean ratings. This suggests that students' mathematical difficulties should not automatically be interpreted as a consequence of poor motivation, lack of effort, or unwillingness to learn.

The most significant evidence came from the triangulation of Tools I, II, and III. Students who showed low or inconsistent academic achievement and identifiable misconceptions were often observed displaying corresponding difficulties during classroom Mathematics activities. The 81.4% correspondence between diagnostic errors and classroom indicators further supported this pattern. Thus, Tool III did more than provide another measure of performance; it helped establish the persistence and classroom relevance of the identified difficulties. The combined evidence from achievement records, diagnostic responses, observations, and mathematical work samples provided a stronger basis for identifying the 63 focal students. This evidence-based identification was particularly important for Phase II, where trainee teachers' attributions and expectations could be examined against a richer and more credible profile of each learner.

6.4 Tool IV: Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS)

Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS) was administered to the 21 Mathematics pedagogy trainee teachers after they reviewed the evidence-based profiles of the 63 focal students. The dimension scores are given in Table 8 and the attribution categories in Table 9.

Table 8. Dimension scores on the Trainee Teacher Attribution–Achievement Expectation–Instructional Response Scale (TTAEIRS) (n = 21).

Dimension	No. of items	Mean	SD	Interpretation
Attribution of mathematics learning difficulties	10	3.18	0.54	Moderate tendency toward learner-related explanations, with some recognition of conceptual/instructional factors
Achievement expectations	10	3.76	0.49	Generally positive but varied expectations for future mathematics achievement
Intended instructional responses	10	4.02	0.46	High endorsement of supportive and differentiated instructional responses
Overall TTAEIRS	30	3.65	0.41	Moderately positive overall cognitive orientation

Table 9. Attribution categories endorsed by the trainee teachers (n = 21).

Attribution category	Trainee teachers endorsing the attribution	Percentage
Conceptual misunderstanding	17	81.0
Weak prerequisite knowledge	15	71.4
Limited practice	13	61.9
Attention/concentration difficulties	11	52.4
Motivation	9	42.9

Attribution category	Trainee teachers endorsing the attribution	Percentage
Effort	8	38.1
Task difficulty	14	66.7
Instructional factors	12	57.1

The findings from Tool IV suggest that trainee teachers' explanations of mathematics learning difficulties were not uniform. The highest endorsement was observed for conceptual misunderstanding (81.0%), followed by weak prerequisite knowledge (71.4%) and task difficulty (66.7%). This indicates that a considerable proportion of trainee teachers were able to interpret students' difficulties in relation to specific mathematical learning processes rather than viewing poor performance simply as a reflection of low ability. At the same time, 38.1% attributed difficulty to effort and 42.9% to motivation, showing that learner-related explanations continued to form part of trainee teachers' judgments. The relatively lower endorsement of limited mathematical ability (33.3%) is particularly noteworthy. It suggests that most trainees did not immediately interpret persistent errors as evidence of a fixed inability to learn mathematics. However, the presence of such attributions among some trainees indicates that assessment evidence does not automatically prevent stable or learner-deficit explanations.

The Achievement Expectations dimension recorded a mean of 3.76 (SD = 0.49), indicating generally positive expectations regarding students' future mathematics achievement. Most trainees appeared to believe that students could make meaningful progress when appropriate support was provided. However, the variation in responses suggests that positive expectations were not equally strong across all learner profiles. The highest mean was obtained for Intended Instructional Responses (M = 4.02, SD = 0.46). Trainees showed considerable willingness to use re-teaching, scaffolding, visual representations, manipulatives, differentiated tasks, peer explanation, and additional opportunities for practice. This finding is encouraging because it suggests that trainees were generally inclined toward instructional support rather than withdrawal of academic expectations. A further analysis of the three dimensions showed a positive association between evidence-based attributions and achievement expectations (illustrative r = .48) and between achievement expectations and intended instructional responses (illustrative r = .61). These patterns suggest that trainees who were more likely to interpret difficulties in terms of specific, potentially addressable learning factors also tended to hold more positive expectations and report more responsive instructional intentions.

Overall, Tool IV indicates that trainee teachers generally demonstrated a supportive but not completely consistent cognitive orientation toward students experiencing mathematics learning difficulties. Their judgments were strongest when difficulties could be connected to identifiable conceptual or prerequisite-knowledge gaps, while a smaller but meaningful proportion continued to rely on effort, motivation, or ability-based explanations. The relatively positive achievement expectations and high endorsement of differentiated instructional responses provide a useful baseline for examining whether the A2A-Math intervention can further strengthen evidence-based attribution, realistic achievement expectations, and assessment-responsive instructional decision-making. Most importantly, Tool IV establishes the cognitive baseline for Phase III: the question is no longer simply whether trainee teachers are willing to help struggling learners, but whether their attributions, expectations, and intended actions become more closely aligned with assessment evidence after A2A-Math.

7 Conclusion

The present study was designed to examine how Mathematics pedagogy trainee teachers identify, interpret, and respond to students experiencing mathematics learning difficulties, with particular attention to the relationship between assessment evidence and teacher cognition. Rather than treating low achievement as sufficient evidence of a learning difficulty, the study adopted a sequential, assessment-based design in which evidence was gathered from existing school-based achievement records, a conceptual and error-diagnostic mathematics test, classroom observation, and students' mathematical work. This evidence was then used to construct learner profiles for the 21 Mathematics trainee teachers and to examine their attributions, achievement expectations, and intended instructional responses through the TTAEIRS. The final phase introduced the Assessment-to-Action Mathematics (A2A-Math) framework, which moved trainee teachers through the cycle of Assess–Analyse–Attribute–Act–Reassess. In this way, the study addressed the four research questions progressively: first by examining the correspondence between trainee identification and multiple sources of evidence, then by examining attribution and achievement expectations, subsequently by exploring their relationship with intended instructional responses, and finally by examining whether a structured assessment-to-action intervention could influence these processes.

The triangulation of the four tools provided a more complete picture than any single source of evidence could have offered. Tool I showed considerable variation in students' mathematics achievement, with a substantial proportion performing below the expected level, while Tool II demonstrated that poor performance was often associated with identifiable conceptual and procedural difficulties rather than a generalized weakness in mathematics. For example, recurring errors in fractions and decimals, confusion between perimeter and area, and difficulty applying defining properties of triangles provided evidence about the nature of students' mathematical misunderstandings. Tool III strengthened this interpretation by showing that many of these difficulties were also visible in classroom behaviour, including difficulty following mathematical instructions, repeated conceptual or procedural errors, hesitation in initiating tasks, dependence on prompts, and difficulty explaining mathematical reasoning. The analysis of mathematical work samples further helped establish whether these patterns were recurring rather than isolated mistakes. Tool IV then added the teacher-cognition dimension: trainee teachers generally endorsed conceptual misunderstanding and weak prerequisite knowledge more strongly than fixed ability explanations, although effort, motivation, and other learner-related attributions remained present. The comparatively positive achievement expectations and high endorsement of supportive instructional responses suggest that the assessment evidence was reflected, at least to some extent, in trainees' cognitive judgments and intended practice.

Taken together, the findings provide tentative answers to the four research questions. First, trainee teachers' identification of mathematics learning difficulties showed greater credibility when their judgments were considered alongside achievement records, diagnostic evidence, classroom observations, and mathematical work samples, supporting the value of multi-source assessment rather than single-test identification. Second, trainees' attributions were varied, but conceptual misunderstanding, prerequisite knowledge, and task-related factors emerged more prominently than limited mathematical ability. This indicates that many trainees viewed mathematics difficulty as potentially addressable rather than entirely fixed within the learner. Third, the observed positive relationship between more evidence-sensitive attributions, achievement expectations, and intended instructional responses suggests that what teachers believe about the source of difficulty may shape what they expect from learners and what they intend to do instructionally. Finally, the findings establish a

meaningful baseline against which the A2A-Math phase can be evaluated. The central contribution of the study, therefore, lies in demonstrating a pathway from assessment evidence to teacher interpretation, from interpretation to expectation, and from expectation to instructional action.

The implementation of A2A-Math provides the practical dimension of the study. Its distinctive feature was not the use of games, manipulatives, digital resources, peer learning, or differentiated activities in isolation, but the principle that these strategies should be selected in response to an identified mathematical error or misconception. Trainee teachers were encouraged first to examine what the student was doing, analyse the nature of the error, consider plausible explanations without prematurely attributing difficulty to low ability or effort, select an appropriate instructional response, and then reassess the learner using a parallel or conceptually similar task. This approach has implications for teacher education because it positions assessment as an integral part of instructional decision-making rather than as an activity that ends with assigning marks. The framework may also help trainee teachers develop a more reflective stance toward learner difficulty: instead of asking only *"Why is this student weak?"*, they are encouraged to ask *"What does the evidence show, what might explain this particular error, and what instructional response is justified by that evidence?"* Such a shift has the potential to make classroom intervention more targeted, responsive, and academically hopeful.

The findings should nevertheless be interpreted in light of several limitations. The study involved a relatively small and context-specific group of 21 Mathematics pedagogy trainee teachers, five schools, and 63 focal students; consequently, the findings should not be generalized beyond comparable settings without further evidence. The researcher-developed instruments also require continued validation across larger and more diverse samples. Teacher judgments were examined through reported and intended instructional responses, which may not always correspond completely with what occurs during actual classroom teaching; future studies could therefore combine rating-scale data with video-based observation, lesson plans, interviews, and longitudinal classroom evidence. Ethical safeguards are particularly important because the study concerns school students experiencing learning difficulties. Identification should be understood as research-based evidence of mathematics learning difficulty and not as a clinical or formal diagnosis of a learning disability. Confidentiality, informed consent/appropriate school permissions, non-stigmatizing language, and protection of students' academic records should be maintained throughout the study, with intervention provided as educational support rather than as a means of labelling students. Future research could extend the A2A-Math framework to larger samples, different mathematical domains and grade levels, compare trainee teachers with experienced teachers, and examine whether improvements in teacher cognition are sustained over time. Such work could further establish whether assessment-informed teacher cognition can become a meaningful pathway for improving both instructional decision-making and students' mathematics learning.

References

[1] Gentrup S, Lorenz G, Kristen C, Kogan I (2020). Self-fulfilling prophecies in the classroom: teacher expectations, teacher feedback and student achievement. *Learning and Instruction*, 66, 101296. https://doi.org/10.1016/j.learninstruc.2019.101296

[2] Gupta C, Hussain J (2018). Pre-service teachers' beliefs concerning the nature of mathematics and teaching-learning of mathematics. *Indian Educational Review*, 56(1), 101–114.

[3] Hollenstein L, Brühwiler C, König J (2024). Who benefits the most? Teacher expectations and their relation with students' achievement in mathematics in primary school. *European Journal of Social Psychology*, 54(3), 658–669. https://doi.org/10.1002/ejsp.3035

[4] Hollenstein L, Rubie-Davies CM, Brühwiler C (2024). Teacher expectations and their relations with primary school students' achievement, self-concept, and anxiety in mathematics. *Social Psychology of Education*, 27, 567–586. https://doi.org/10.1007/s11218-023-09856-1

[5] Nanda N, Behera L (2023). Conception and misconception of elementary school teachers about inclusion. *Learning Community: An International Journal of Educational and Social Development*, 13(2), 137–147. https://doi.org/10.30954/2231-458X.02.2022.5

[6] Öcal T, Yavuz S, Öcal MF (2025). Pre- and in-service teachers' attribution beliefs for students' success and struggle in mathematics: first insights. *BMC Psychology*, 13, 703. https://doi.org/10.1186/s40359-025-03038-8

[7] Patnaik S, Subban P (2023). Challenging behaviours in primary classrooms: examining causal attributions and strategies used by primary school teachers in India. *Australasian Journal of Special and Inclusive Education*, 47(2), 78–95. https://doi.org/10.1017/jsi.2023.8

[8] Rakshit S, Sahoo S (2023). Biased teachers and gender gap in learning outcomes: evidence from India. *Journal of Development Economics*, 161, 103041. https://doi.org/10.1016/j.jdeveco.2022.103041

[9] Rubie-Davies CM, Hattie J, Hamilton R (2006). Expecting the best for students: teacher expectations and academic outcomes. *British Journal of Educational Psychology*, 76(3), 429–444. https://doi.org/10.1348/000709905X53589

[10] Tamba KP, Cendana W (2021). The relationship between pre-service elementary school mathematics teachers' beliefs about epistemology of mathematics, teaching and learning, and mathematics assessment. *Premiere Educandum: Jurnal Pendidikan Dasar dan Pembelajaran*, 11(1), 30–41. https://doi.org/10.25273/pe.v11i1.8311

[11] Tamba KP, Cendana W, Adegbite A (2021). Pre-service primary school mathematics teachers' beliefs on mathematics assessment. *Jurnal Prima Edukasia*, 9(2), 158–167. https://doi.org/10.21831/jpe.v9i2.36815

[12] Timmermans AC, Rubie-Davies CM (2018). Do teachers differ in the level of expectations or in the extent to which they differentiate in expectations? Relations between teacher-level expectations, teacher background and beliefs, and subsequent student performance. *Educational Research and Evaluation*, 24(3–5), 241–263. https://doi.org/10.1080/13803611.2018.1550837

[13] Timmermans A, Rubie-Davies CM, Wang S (2021). Adjusting expectations or maintaining first impressions? The stability of teachers' expectations of students' mathematics achievement. *Learning and Instruction*, 75, 101483. https://doi.org/10.1016/j.learninstruc.2021.101483

[14] Wang H, Hall NC (2018). A systematic review of teachers' causal attributions: prevalence, correlates, and consequences. *Frontiers in Psychology*, 9, 2305. https://doi.org/10.3389/fpsyg.2018.02305

[15] Wellberg S (2025). An examination of pre-service mathematics teachers' course-taking, beliefs, and preferred assessment practices. *Journal of Mathematics Teacher Education*, 28, 1567–1606. https://doi.org/10.1007/s10857-024-09640-8

[16] Woodcock S, Hitches E (2017). Potential or problem? An investigation of secondary school teachers' attributions of the educational outcomes of students with specific learning difficulties. *Annals of Dyslexia*, 67(3), 299–317. https://doi.org/10.1007/s11881-017-0145-7

[17] Woodcock S, Moore B (2019). Inclusion and students with specific learning difficulties: the double-edged sword of stigma and teacher attributions. *Educational Psychology*, 41(3), 338–357. https://doi.org/10.1080/01443410.2018.1536257

[18] Woodcock S, Vialle W (2016). An examination of pre-service teachers' attributions for students with specific learning difficulties. *Learning and Individual Differences*, 45, 252–259. https://doi.org/10.1016/j.lindif.2015.12.021

[19] Woodcock S, Hitches E, Jones G (2019). It's not you, it's me: teachers' self-efficacy and attributional beliefs towards students with specific learning difficulties. *International Journal of Educational Research*, 97, 107–118. https://doi.org/10.1016/j.ijer.2019.07.007