



The Influence of Learning Outcome Assessment Perception on Teachers' Beliefs about Mathematics Learning

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Abstract

The paradigm in assessing mathematics learning outcomes has turned, especially after the pandemic and the enactment of the Kurikulum Merdeka. Assessment serves to not only determine learning objectives, but also as a process and tool for learning. Nevertheless, attitudes toward the assessment of mathematics learning outcomes can be mediated by several factors, such as the teachers' conceptions of mathematics learning. This study aims to examine the effect of perceptions of assessments on teachers' beliefs about mathematics learning. This study employed a correlational design involving 69 mathematics teachers from 20 provinces in Indonesia. Student characteristics are classified by gender, educational stage, teaching experience, and highest academic qualification. A Google Form was distributed through WhatsApp groups to obtain data. The data were analyzed using simple analysis, contingency correlation, and SEM analysis. Results indicate that teachers generally continue to use AoL format rather than AfL and AaL in assessing mathematics learning outcomes. The association between differentiation factors and mathematics teachers' beliefs was generally weak to very weak. School level and teaching experience showed a low correlation with mathematics teachers' beliefs. The mediating role of teachers' beliefs about learning assessment accounted for 32% teachers' beliefs about mathematics learning. This study emphasizes the necessity for educational interventions that promote practical classrooms applications to develop teachers' attitudes of the importance of AfL and AaL. Future researchers may conduct longitudinal studies with a larger number of participants and a more equal distribution of characteristics to minimize bias and obtain most comprehensive results.

Keywords: assessment perception, teacher beliefs, mathematics, learning outcomes, correlational study.



INTRODUCTION

Assessment is an important activity to improve the learning process and measure the achievement of learning objectives. However, teachers generally only use assessment to map student learning outcomes (Earl & Katz, 2006). Rather than recognizing students' learning potential, assessment is often used merely as a tool to determine graduation (Chong, 2018; Earl & Katz, 2006; Nisbet & Warren, 2000). In mathematics learning, most teachers only assess the cognitive aspect (Sugiri & Priatmoko, 2020). Mathematics, as a subject that involves abstract concepts, also influences teachers' perceptions and beliefs in assessing student learning outcomes (Delandshere & Jones, 1999; Polly et al., 2013; Stipek et al., 2001).

Various reports show that teacher beliefs consistently influence teaching actions and practices (Barkatsas & Malone, 2005; Stipek et al., 2001). Teacher beliefs are essential in determining how teachers teach and make classroom decisions. Teacher beliefs include beliefs about the nature of mathematics, how mathematics can be learned, and assessment practices (Quigley, 2021). Studies examining teacher beliefs in mathematics learning have been widely conducted (Barkatsas & Malone, 2005; Nisbet & Warren, 2000; Polly et al., 2013; Xie & Cai, 2021). However, teachers' beliefs on mathematics learning assessment received only limited attention. In particular, studies on mathematics teachers' beliefs have largely focused on higher education in developed countries. In contrast, exploration of mathematics teachers' beliefs at the school level in Indonesia remains limited.

The study of teacher beliefs about assessment is relatively new (Martínez-Sierra et al., 2020). On the other hand, the paradigm of educational assessment is increasingly developing and requires teachers to adapt various forms of appropriate assessment (Earl & Katz, 2006; Öz, 2014). This shift aims to identify successes, obstacles, and necessary follow-up improvements. However, teacher beliefs limit the use of assessment objectives to recognise obstacles and follow-up improvements in learning (Barkatsas & Malone, 2005). This occurs for several reasons. Teachers often perceive assessment as an effort to distinguish between successful and unsuccessful students. They may also believe that no alternative assessment methods exist beyond those frequently used, and their knowledge of constructing assessment instruments remains inadequate (Handal & Herrington, 2003; Polly et al., 2013). A comprehensive assessment should represent all dimensions of learning outcomes: cognitive, affective, and psychomotor (Tandililing et al., 2025). Assessment practices that focus primarily on mental aspects may narrow teachers' beliefs about the success of mathematics learning.

The government has launched the "*Kurikulum Merdeka*" program to address post-pandemic educational challenges and strengthen 21st-century life skills. Post-pandemic education has entered an era of disruption that increasingly requires innovation, including in how teachers assess learning outcomes (Andiani et al., 2020; Nasution, 2021). This context has led to the emergence of various assessment practices that were previously uncommon, including authentic assessment (Kristanto & Yuniarta, 2021). In the "*Kurikulum Merdeka*", authentic learning outcome assessments involving various aspects remain highly relevant (Rosidah et al., 2021). Authentic assessment is a meaningful measurement of student learning outcomes in attitudes, skills, and knowledge in an integrated manner. Research by Sjafruddin's (2015) indicates that teachers' perceptions of authentic assessments are generally positive. However, there still limited in-depth evidence regarding teachers' perceptions of the success of authentic assessments, especially in shaping teacher beliefs. Authentic assessments are not only limited to pencil and paper tests that measure cognitive aspects, but also includes product-based assessments, projects, performance, and self-assessments that can measure affective and psychomotor aspects. Meanwhile, various research reports state that teachers remain constrained by traditional assessment paradigm (Polly et al., 2013; Stipek et al., 2001) and have not been able to develop authentic assessment instruments (Nasution, 2021; Sugiri & Priatmoko, 2020). The assessment paradigm is therefore viewed not only as a means of measuring learning success but also as a tool for improving the quality of learning (Earl & Katz, 2006). Teachers' perceptions and beliefs are closely related to their practical actions in the learning process (Stipek et al., 2001), including the assessment of mathematics learning outcomes (Barkatsas & Malone, 2005). However, the report regarding the perception of assessment in shaping teacher confidence post-pandemic, especially after the implementation of the *Kurikulum Merdeka* remains limited.

Perception is an individual's point of view when assessing something (Sjafruddin et al., 2015). Teachers' perceptions of mathematics learning outcome assessments influence the types of assessments they consider most appropriate and consistently implement. Teachers who successfully adapt assessment formats may further strengthen their beliefs about mathematics learning, and vice versa. Ultimately, teachers develop beliefs about certain assessment paradigms (Earl & Katz, 2006). Three assessment paradigms can form the basis for teacher beliefs (Earl, 2003): (1) assessment of learning (AoL), (2) assessment for learning (AfL), and (3) assessment as learning (AaL). AoL is an assessment conducted after learning, focusing solely on final results. AfL aims to improve student performance through feedback during the learning process. AaL emphasizes student reflection and self-regulation through active participation. The three assessment paradigms have complementary functions and objectives. Teachers' beliefs about mathematics assessment and learning cannot be separated from the teacher's philosophy, experience, and knowledge (Nisbet & Warren, 2000). Therefore, teachers' beliefs about assessment paradigms are important to understand the form of assessment used by teachers during the mathematics learning process.

Mathematics teachers' perceptions and beliefs are influenced by various characteristics, such as gender, class taught, teaching experience, and qualification level (Nisbet & Warren, 2000). Male and female teachers have different perceptions of teaching connected to brain and emotional dominance. Male teachers generally view mathematics as a formal structure, while female teachers involve students more and often use collaborative learning or discussion (Li, 1999). Differences in teaching class levels also reflect variations in teachers' perceptions and beliefs. Teachers at the elementary school level more often relate mathematical objects to concrete objects, while teachers at the secondary school level have often used the formal nature of mathematics. Teaching experience produces a superior, more creative, and more accurate learning environment. Experienced teachers have higher beliefs in teaching than teachers with less experience (Xie & Cai, 2021). Professional teacher education programs further influence mathematics teachers' perceptions and beliefs, particularly at the elementary school level. Teachers who hold professional certification tend to demonstrate more positive perceptions and stronger beliefs about mathematics.

Research exploring teachers' perceptions and beliefs about mathematics learning outcome assessment remains limited. Previous studies only describe the forms of assessment used by teachers but have not examined the most dominant assessment paradigm and the educational dynamics that require transformative efforts to respond to and reconstruct the concept of learning and assessment in schools (Earl & Katz, 2006). The results of this study are expected to contribute to the development of teachers' perceptions and beliefs about mathematics learning assessment. Furthermore, implementing the *Kurikulum Merdeka* requires support from both effective learning processes and effective assessment practices. This study is expected to provide a theoretical basis for developing alternative assessment instruments aligned with the principles of the *Kurikulum Merdeka* and contemporary assessment paradigms. Based on this description, the research questions of this study are: (1) How do mathematics teachers use the forms of assessment? (2) What is the correlation between gender factors, school level, teaching experience, and education level on mathematics teacher beliefs? and (3) How does the perception of assessment affect teachers' beliefs about mathematics learning?

METHOD

This correlational study aims to describe the forms of assessment used by mathematics teachers, analyze the correlation between differentiating factors and mathematics teachers' beliefs, and analyze the influence of assessment perceptions on teachers' beliefs about mathematics learning. The research participants were mathematics teachers and elementary school teachers who teach mathematics. A total of 69 from 20 provinces in Indonesia were involved in this study. Data were collected from January to April 2024. Participants were classified into four characteristics that impact teacher beliefs and classroom practices (Nisbet & Warren, 2000): gender, school level, teaching experience, and highest education. Teacher beliefs in this study are divided into three types (Swan, 2006): transmission, constructivist, and connectionist. Each type of belief is grouped into three components: the nature of mathematics, mathematics learning, and mathematics teaching.

The research was conducted through several stages. Preparation stage: (1) Collecting information and reading sources related to teacher perceptions and beliefs about mathematics learning. (2) Constructing and validating instruments. Three instruments were used: (a) a list of assessment forms adapted from Earl (2003), (b) a mathematics teacher beliefs questionnaire adapted from Swan (2006), and (c) a questionnaire on teachers' perceptions of mathematics assessment and learning from Nisbet & Warren (2000). The instruments were validated by two experts in mathematics education related to language and readability. A pilot test was not conducted because the questionnaires were adapted from previous researcher's work. Implementation stages: (1) Determining the target population, namely participants in the in-service teacher professional education program at Universitas Musamus, and (2) distributing the questionnaire in the form of a Google form through WhatsApp groups. Recruitment of participants was voluntary, with consent and confidentiality of data stated on the questionnaire that the data was solely for research purposes, and all information was anonymous. Analysis stage: tabulating data, compiling questionnaire results, analyzing data using software, and drawing conclusions (generalization). Data related to mathematics learning outcome assessment were analyzed using quantitative descriptive in the form of percentage analysis and presented in tables/graphs. The correlation between differentiating factors and mathematics teacher beliefs was analyzed using a contingency correlation test. Meanwhile, the influence of assessment perceptions on teachers' beliefs about mathematics learning was analyzed using SEM with the Smart-PLS application.

RESULTS

There were 18 male participants (26.1%) and 51 female participants (73.9%). The participants consisted of 34 elementary school teachers (49.2%), 23 junior high school teachers (32.9%), and 12 senior high school teachers (17.9%). One teacher had less than 1 year of teaching experience (1.4%), eight teachers had 1-5 years of experience (11.6%), 22 teachers had 5–10 years of experience (31.9%), 30 teachers had 10–20 years of experience (43.5%), and eight teachers had more than 20 years of experience (11.6%). Most participants held a bachelor's degree (65 teachers; 94.2%), while four teachers (5.8%) held a master's degree. Most participants came from the Maluku and Papua regions (39.13%). In additions 65.22% of teachers were from rural areas, while 69.56% were from coastal areas. Information related to the distribution of participants is shown in Table 1.

Table 1. Distribution of participants by province of origin

Province	N	Gender		School Level			Teaching experience (year)					Graduate	
		Male	Female	ES	JHS	SHS	<1	1-5	5-10	10-20	>20	S1	S2
South Papua	14	1	13	5	5	4	0	0	7	6	1	14	0
South Sulawesi	9	3	6	1	1	7	1	3	1	3	1	9	0
Riau Islands	7	1	6	7	0	0	0	0	1	5	1	7	0
South Sumatera	5	2	3	4	1	0	0	0	0	2	3	4	1
East Java	5	2	3	5	0	0	0	2	3	0	0	5	0
North Maluku	5	2	3	5	0	0	0	0	1	4	0	5	0
Papua	5	1	4	0	5	0	0	1	3	0	1	5	0
South Kalimantan	4	1	3	0	4	0	0	0	0	3	1	3	1
Bengkulu	3	2	1	0	3	0	0	1	0	2	0	3	0
Central Java	2	1	1	1	1	0	0	1	1	0	0	1	1
Central Sulawesi	2	0	2	0	2	0	0	0	2	0	0	2	0
Central Papua	2	1	1	2	0	0	0	0	0	2	0	2	0
West Sumatera	1	0	1	1	0	0	0	0	1	0	0	1	0
Bali	1	1	0	1	0	0	0	0	1	0	0	1	0
North Sulawesi	1	0	1	0	0	1	0	0	1	0	0	1	0
West Sulawesi	1	0	1	0	1	0	0	0	0	1	0	0	1

Province	N	Gender		School Level			Teaching experience (year)					Graduate	
		Male	Female	ES	JHS	SHS	<1	1-5	5-10	10-20	>20	S1	S2
Southeast Sulawesi	1	0	1	1	0	0	0	0	0	1	0	1	0
Papua Highlands	1	0	1	1	0	0	0	0	0	1	0	1	0
Total	69	18	51	34	23	12	1	8	22	30	8	65	4

Teachers use various assessment instruments in the learning process. Based on their functions, assessment instruments are classified into AfL, AaL, and AoL. Teachers use live worksheets as a mathematics learning assessment (87%). In addition, observation sheets are used by 60.9% teachers in the learning process. Assessment as learning remains relatively uncommon among teachers. For example, teachers use reflective journals (17.4%), self-assessments (33.3%), peer assessments (23.2%), portfolios (34.8%), student profiles (8.7%), and checklists (2.9%). In contrast, mathematics teachers often use assessment to measure learning outcomes, as indicated by the use of exams (75.4%), and homework (62.3%). Technology-based assessment has been implemented, although it remains limited (11.6%). Performance-based assessments have also been used, including presentations (43.5%), role-playing (14.5%), and the use of audio or video cassettes (4.3%). The assessment instruments used by teachers are shown in full in Table 2.

Table 2. Forms of assessment used by teachers

Forms of assessment	N	(%)	Forms of assessment	N	(%)
Live worksheet	60	86.96%	Logbook	7	10.14%
Test/Quiz	52	75.36%	Interview	7	10.14%
Homework	43	62.32%	Students profile	6	8.70%
Observation	42	60.87%	Anecdotal notes	4	5.80%
Presentation/Demonstration	30	43.48%	Parent-teacher meeting	4	5.80%
Rubric	26	37.68%	Investigation project	3	4.35%
Portfolio	24	34.78%	Video/audio/photo	3	4.35%
Self-assessment	23	33.33%	Report card	3	4.35%
peer assessment	16	23.19%	achievement record	3	4.35%
Reflective journal	12	17.39%	Checklist	2	2.90%
Role play (simulation)	10	14.49%	Assessment bulletin	1	1.45%
Computer based test	8	11.59%	Continuity of development	0	0.00%

In the component of the nature of mathematics, most teachers have a transmission, viewing mathematics as knowledge with specific rules and universal truth (46.4%). However, some teachers have a constructivist belief, viewing mathematics as allowing creativity to discover concepts through their methods (43.5%). Meanwhile, a small number of teachers have a connection belief, viewing mathematics as related to shared ideas between students and teachers through discussion (10.1%). In contrast to beliefs about the nature of mathematics, teachers' beliefs about learning mathematics are more often constructivist (52.2%) than transmission-oriented (27.5%). Meanwhile, 20.3% of teachers have a connection belief that learning mathematics is an interpersonal activity where students experience challenges until they understand something through discussion.

Furthermore, in teaching mathematics, most teachers believe that teaching requires explanations through exercises and correction of mistakes (58%). Teachers who support a constructivist approach, emphasizing exploratory learning environments, represent 33.3%, while those with a connectionist approach, emphasizing verbal discussion between teachers and students, represent 8.7%. Teachers' responses regarding beliefs about mathematics, learning, and teaching are shown in Table 3.

Table 3. Teachers' beliefs about the nature, learning, and teaching of mathematics

Component	Teachers' beliefs about the nature of mathematics	N (%)
Transmission	Mathematics is a science with specific standard procedures, a set of universal truths and rules that must be conveyed to students	32 (46,4%)

Component	Teachers' beliefs about the nature of mathematics	N (%)
Constructivist	Since mathematics is a creative topic, teachers must act as facilitators, letting pupils develop their ideas and approaches	30 (43,5%)
Connectionist	Teachers and students collaborate to develop a corpus of connected concepts in mathematics through conversation	7 (10,1%)
Component	Teacher beliefs about mathematics learning	N (%)
Transmission	Learning is a personal process that involves seeing, hearing, and copying until fluency is attained	19 (27,5%)
Constructivist	Learning is a collaborative endeavour grounded in experiential investigation and contemplation	36 (52,2%)
Connectionist	Learning is a collaborative endeavour in which students are stimulated and achieve comprehension through dialogue	14 (20,3%)
Component	Teacher beliefs about mathematics teaching	N (%)
Transmission	Formulating a sequential curriculum for pupils; delivering verbal elucidations and verifying comprehension through practical exercises; rectifying misconceptions when students do not grasp the material	40 (58%)
Constructivist	Evaluating pupils when they are prepared to learn; creating an engaging atmosphere to encourage inquiry; Preventing misinterpretations by carefully ordering experiences	23 (33,33%)
Connectionist	A non-linear conversation in which students and teachers discuss relationships and meanings. Misunderstandings are addressed and clarified.	6 (8,7%)

The majority of teachers hold a transmission belief, viewing mathematics as static knowledge governed by fixed rules. Most teachers also consider mathematics as a static subject with only right or wrong answers. However, teachers' beliefs about how to learn and teach tend to favor constructivism. This difference indicates that, while teachers theoretically recognize the importance of students constructing their understanding (constructivism), their fundamental view of mathematics itself remains rooted in the transmission model. This creates a tension, where teachers may attempt to implement student-centered learning while still regarding mathematics as a set of facts to be transmitted. This mindset can hinder consistent application of constructivist approaches, particularly when mathematics is seen primarily as formulas to memorize.

Table 4 shows the correlation between differentiating factors such as gender, school level, teaching experience, education level, and mathematics teachers' beliefs.

Table 4. Contingency correlation test

Beliefs about	Factor	Correlation	sig.	Conclusion
The nature of mathematics	Gender	0.026	0.977	Very weak
	School level	0.21	0.526	Weak
	Teaching experience	0.395	0.12	Weak
	Graduate	0.147	0.469	Very weak
Mathematics learning	Gender	0.083	0.788	Very weak
	School level	0.451	0.001	Moderate
	Teaching experience	0.314	0.477	Weak
	Graduate	0.185	0.293	Very weak
Mathematics teaching	Gender	0.097	0.72	Very weak
	School level	0.361	0.035	Weak
	Teaching experience	0.405	0.093	Moderate
	Graduate	0.105	0.681	Very weak

The relationship between differentiating factors and three components of mathematics teacher beliefs, including beliefs about the nature of mathematics, beliefs about learning mathematics, and

beliefs about teaching mathematics, falls in the weak to very weak categories. This indicates that differentiating factors are not strongly correlated with teachers' beliefs regarding the nature of mathematics, learning, and teaching mathematics. However, the relationship between teaching experience and teachers' beliefs about teaching mathematics shows that teaching experience plays an important role in determining teachers' beliefs about teaching mathematics. This means that the longer a teacher teaches, the stronger teacher's beliefs about effective teaching methods become. This can be a double-edged sword; experience can lead to the development of better practices, but it can also reinforce rigid beliefs that are difficult to change if those practices are not based on critical reflection.

Teachers generally responded positively (agree and strongly agree) to most items. Teachers gave strongly agreed responses (60.9%) regarding assessment as a tool to evaluate the effectiveness of learning, determine student learning development (55.2%), identify students' potential abilities (55.1%), and provide feedback (36.2%). However, some teachers responded negatively (strongly disagree and disagree) to several items. Negative responses were reported regarding the ability of assessment to provide information about what students do not yet know (4.3%) to provide information for students who are still learning (7.2%), the function of assessment as an administrative requirement (8.6%), and the function of assessment to assess facts and rules rather than as a problem-solving tool (49%). Teachers' responses about the function of assessment in mathematics learning are shown in Table 5.

Table 5. Teachers' perceptions of mathematics learning assessment

Statement	Average	Standard deviation
Assessment is useful for evaluating the effectiveness of teaching	3.61	0.49
Assessments can be used to determine how well a class is progressing	3.52	0.50
Assessment can help me identify students who are having problems	3.46	0.53
Assessment can help me plan the next phase in teaching	3.45	0.53
Assessment can tell me about the potential level of student ability	3.55	0.50
Assessment tells students what they don't know	3.29	0.54
Assessment encourages students to study the results of their work	3.33	0.47
Assessment provides information to students who have successfully achieved learning objectives	3.46	0.50
Assessments tell students what they are learning	3.19	0.55
Assessment provides feedback about students' strengths and abilities	3.36	0.48
Assessments are used to inform parents about student performance results	3.42	0.52
Assessment becomes a tool to fulfill school administration requirements	3.22	0.63
I tend to value rules and facts rather than having students solve problems	2.59	0.69

Teachers' responses regarding mathematics learning varied widely. Many teachers perceived mathematics as a static subject (84.1%) that has remained unchanged over time (71.1%). Teachers also perceived mathematics as only having right or wrong rules (81.2%). However, mathematics was perceived as related to patterns found in the surrounding environment (94.2%). Most teachers perceived mathematics as a calculation concept (81.1%), so students must learn formulas (91.3%). As a result, teachers perceived guided tasks and exercises as the best way to learn mathematics (85.5%). Teachers avoided project assignments and investigations when assessing students' mathematics performance (72.4%). Most teachers reported teaching mathematical concepts related to real-life contexts (98.6%) and using concrete objects in teaching (94.2%). On the other hand, teachers considered problem-solving in real-world contexts an important part of mathematics learning (94.2%). Teachers' perceptions regarding mathematics learning are shown in Table 6.

Table 6. Teachers' perceptions of mathematics learning

Statements	Average	Standard deviation
Mathematics is a subject that never changes (static)	3.03	0.64
The advantage of mathematics is that everything is either true or false	2.99	0.60
Mathematics today is no different from mathematics in the past	2.83	0.66
Mathematics is dynamic according to patterns found in the environment	3.20	0.58
Students learn mathematics best through guided tasks and practice	3.09	0.65
Mathematics is basically about calculations	2.97	0.59
The problem with low student performance is because they do not learn formulas (rules)	2.88	0.58
Formulas (rules) are very important for students to learn to get answers and solve problems	3.12	0.53
The main tool I use to assess students is through timed tests rather than giving project assignments or investigations	2.84	0.65
Mathematics is difficult to plan for direct experiences in learning	2.58	0.62
I teach interesting things about mathematics and its relationship to life outside of school	3.33	0.50
Students need concrete objects to help learn mathematics	3.36	0.59
I teach mathematics that has nothing to do with students' lives outside of school	2.14	0.60
Collecting observational data made by students only wastes learning time	2.16	0.65
Solving challenges in real-world situations helps students learn more effectively	3.28	0.61
Pupils who perform well on routine tasks may not perform well on assessments	2.74	0.58
Peer tutoring is the practice of students teaching one another and sharing their thoughts	3.23	0.46
Students must complete tasks correctly	3.22	0.51

Teachers expressed very positive attitudes toward the use of assessments for evaluation, feedback, and determining student progress. The majority also believed that mathematics is related to patterns in the environment and real-world problem-solving. However, the data showed that teachers still rely heavily on traditional teaching methods. Most teachers considered guided tasks and practice to be the best approach and avoided project or investigative assignments. This indicates a gap between intentions and actions, or a difference between expressed beliefs and actual practice. Although teachers agreed with modern, holistic approaches, such as performance-based assessment and problem-solving, they remained dependent on teaching and assessment practices centered on procedures and algorithms. They may recognize the value of new approaches but have not yet fully internalized or implemented them in their daily practice.

Furthermore, the influence of teacher's perceptions about learning assessment (X) on teacher's beliefs about mathematics learning (Y) was analyzed using SEM. The SEM diagram model illustrating the relationship between variables is shown in Figure 1.

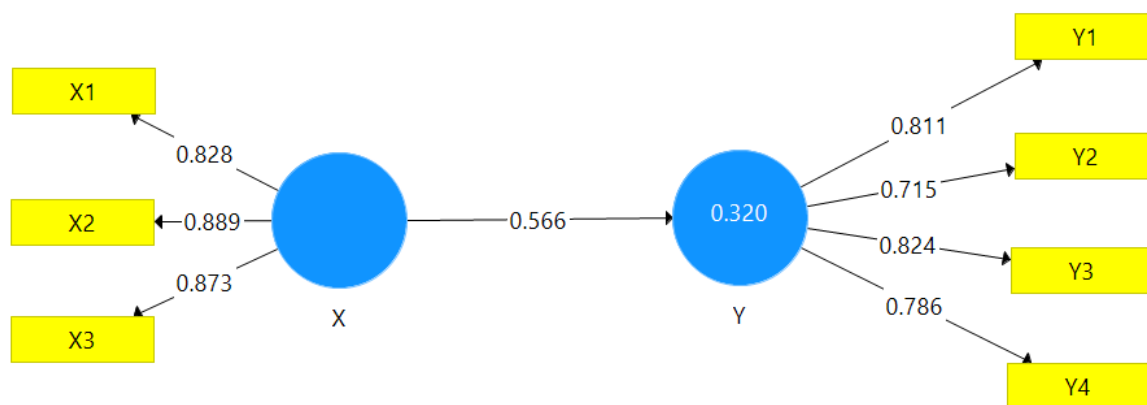


Figure 1. Structural model

Figure 1 shows that all constructs of variables X and Y meet the loading factor >0.7 , indicating that each indicator can explain its latent variable well. Teachers' perceptions of learning assessment contribute 0.566 units to teachers' beliefs about mathematics learning. The reliability values of variables X and Y are 0.836 and 0.795, respectively, indicating that the instrument is reliable. The discriminant validity results show 0.877, exceeding the correlation value between latent variables, indicating good discriminant validity. The coefficient of determination value is 0.32, suggesting that teachers' perceptions of learning assessment contribute 32% to teachers' beliefs about mathematics learning. It implies that the way teachers perceive and utilize assessment goes beyond merely a measuring determinant of their beliefs regarding how students learn. If teachers perceive assessment as a quiz with facts and rules, they tend to possess beliefs about learning that emphasize memorization. On the other hand, if they perceive assessment as a way to investigate students' understanding at a greater depth, then their beliefs will come to adopt a more constructivist perspective. Assessment is not just a reflection of what teachers think, but also shapes them. Consequently, to achieve a deep change in teaching interventions should start with shifting teachers' views and use of assessment.

DISCUSSION

The study findings indicate a paradigm shift in mathematics assessment, from being primarily outcome-oriented (AoL) to focusing more on the learning process (AfL) and assessment as learning (AaL). The use of alternative methods such as worksheets, observations, and demonstrations demonstrates that teachers start to adopt a more comprehensive assessment approach to uncovering students' mathematical thinking and behavior (Suurtamm et al., 2016). However, the analysis reveals the persistence of strong traditional assessment beliefs, particularly among teachers in rural areas. Although educational reforms encourage the use of formative assessments (AfL and AaL), teachers remain using summative assessments (AoL) such as tests, quizzes, and homework. This finding aligns with research by Oz (2014) and Chong (2018), asserting that conventional assessment cannot be replaced entirely. This finding reinforces the belief that written tests are the most valid and objective way to measure content mastery, consistent with teachers' educational experiences as students, including in their choice of assessment methods (Sawyer, 2018).

AfL and AaL assessment methods are rarely used because they are considered impractical or irrelevant to the abstract nature of mathematics. This supports the findings of Ferretti et al. (2021), who stated that most teachers believe that assessing mathematics content knowledge should involve accuracy, participation, and commitment. The belief that mathematics is a subject focused on demonstrating mathematical skills (e.g., calculating, problem-solving) leads teachers to prefer assessment methods that directly measure these skills, such as written tests. This reinforces Earl & Katz (2006) argument that teachers' beliefs about learning influence their assessment choices. The paradox between the goals of educational reform and teachers' internal beliefs about the nature of mathematics and its assessment poses a challenge to the development of teacher professional education. Similarly, Gagnier (2022) noted that teachers believe their skills can improve through training. Therefore, explicit interventions are needed, including practical implementation in the classroom, to help teachers understand the importance of AfL and AaL (e.g., to foster student metacognition).

The results of this study reveal a notable contradiction in mathematics teachers' beliefs. Teachers tend to view mathematics as a static subject focused on right or wrong answers and standard procedures (transmission view). However, teachers also believe that learning mathematics can be conducted exploratively through the construction of knowledge (constructivist view). Ironically, although constructivist beliefs are more dominant in viewing the learning process, their teaching practices are dominated by transmission beliefs, such as teaching sequentially and systematically and directly correcting student errors. This finding aligns with Swan (2006) and Polly et al. (2013), who reported that teachers often face a dilemma between beliefs and practices. Teachers' beliefs can interplay with classroom practices (Quigley, 2021). They may believe in a more student-centered (constructivist) approach, but various factors, such as curriculum demands, time pressures, habits, and school culture influence classroom practices. This creates cognitive dissonance, where ideal beliefs are at odds with the realities of daily teaching practice. Professional development interventions are needed to shift teachers' beliefs to be more constructivist and student-centered. This aligns with Eichler & Isaev (2023),

who found that professional development interventions significantly influences mathematics teachers' beliefs. Furthermore, teacher training programs should develop teachers' beliefs and positive attitudes toward mathematics (Segarra & Julià, 2022).

Teachers' beliefs about mathematics directly influence their assessment practice. If teachers view mathematics as a static subject, their assessments tend to be traditional, focusing on written tests that measure the ability to memorize formulas and find a single correct answer. This type of assessment does not allow students to explore, argue, or demonstrate their thinking processes. Teachers need opportunities to apply constructivist approaches in a safe environment, such as workshops, lesson studies, or peer coaching. This aligns with the findings of Nguyen & Tran (2023), who found that using challenging tasks during lesson studies can shift teachers' perceptions from transmitting knowledge (transmitters) to actively engaging students in constructing knowledge (constructivism).

Characteristics of differentiating factors such as gender, school level, teaching experience, and education level are not significantly correlated with mathematics teacher beliefs. Teacher's beliefs about the nature, learning, and teaching of mathematics show a very weak correlation with gender differences. This finding differs from Li (1999) opinion that male teachers perceive mathematics as formal knowledge while female teachers use more collaborative approaches. Meanwhile, Nisbet and Warren (2000) stated that female teachers emphasize the function of assessment as a means of teaching information more than male teachers. Differences in school level moderately correlate with teacher beliefs about mathematics learning. This aligns with the findings of Nisbet and Warren (2000), who stated that lower-graders use more assessments and concrete objects than upper-graders. Similarly, Quigley (2021) states that elementary school teachers incorporate concrete materials in learning strategies to support fluency and automation, directly influencing their beliefs about effective teaching methods.

Teaching experience correlated moderately but not significantly with teachers' beliefs about mathematics teaching. Similarly, Xie and Cai (2021) stated that longer teaching experience does not necessarily orient toward constructivist or connectionist beliefs. Instead, teachers with less experience held views of creativity and autonomy in mathematics teaching. Gagnier (2022) stated that professional training programs can improve teachers' beliefs and influence the success of skill development and self-confidence. However, educational level correlated very weakly with teachers' beliefs. This aligns with Nisbet & Warren (2000), who stated that educational level generally does not show a clear pattern related to teachers' beliefs. Teachers' perceptions of assessment significantly influence their beliefs about mathematics learning. This suggests that the choice of assessment format is closely related to teachers' beliefs about mathematics learning. This finding aligns with Sierra & Garcia (2020) who found that teachers' beliefs play a crucial role in determining the choice of complementary mathematics assessments that require students to demonstrate knowledge or assessments influenced by competency-based learning.

CONCLUSION

Recent educational reforms emphasize the evaluation of learning processes rather than solely final outcomes. Studies reveal that teachers recognize the significance of AfL and AaL-oriented assessment, but their judgments remain dominated by procedures linked to traditional approaches to assessment (AoL), such as tests, quizzes, and homework. This condition indicates that the more holistic assessment paradigm central to the reformed curriculum has not been fully internalized. Educational reform emphasizes a shift from a "transmission" learning paradigm (teacher-centered) to a "constructivist" paradigm (students as active constructors of knowledge). This reveals that although many teachers hold constructivist beliefs, their teaching practices still tend to be transmission-oriented (teaching sequentially, systematically, and directly correcting errors). In the context of educational reform, this presents a significant challenge. A curriculum designed to encourage student exploration and creativity may not run optimally if teachers still adhere to traditional teaching methods.

This research recommends several strategies for improving teacher professional development programs: (1) The importance of training in innovative assessment practices by strengthening training modules that focus on the practical application of AfL and AaL assessments. Training should not be

only theoretical, but must involve simulations, case studies, and direct practice in the field. (2) Dismantling the myth of "Static Mathematics" by helping prospective teachers reconstruct their views on mathematics. Programs must introduce mathematics as a dynamic, creative, and challenging subject rather than merely a collection of standard procedures. (3) Promoting a culture of self-reflection in teacher professional education to help teachers identify gaps between their beliefs about learning and their teaching practices. (4) Needs-based differentiation: The analysis shows that factors such as gender, experience, and education level are not strongly correlated with teacher beliefs. This suggests that teacher professional education programs should focus more on individual needs and continuous professional development rather than categorizing teachers based solely on demographic characteristics.

Limitations of this study include the relatively small number of respondents, which may be below the suggested population expectations. The teachers involved came from various provinces in Indonesia, so differences in regional characteristics may introduce bias. The study was conducted online; therefore, the accuracy of data collection could not be confirmed directly between the researcher and respondents. Recommendations for future studies include increasing the number of respondents and ensuring a more balanced sample distribution across regions and differentiating factors. Future researchers may consider conducting longitudinal studies or intervention studies to analyze the correlation between perceptions of mathematics learning outcomes assessment based on determining factors and mathematics teachers' beliefs.

DECLARATIONS

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