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# Emerging trends in mathematics assessment practices in Southeast Asia

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**ABSTRACT**

Assessment in education has shifted from summative to formative models in recent decades, with technological advancements facilitating flexible implementation anytime and anywhere. Stemming from this phenomenon, this study aims to identify the trends in mathematics learning assessment in Southeast Asia through a systematic literature review (SLR) utilizing the PRISMA protocol. Articles were collected from the Scopus and ERIC databases, yielding an initial 1533 articles, which were then filtered to 39 final articles for analysis. The results indicate that Assessment for Learning is the most frequently studied assessment topic in the context of mathematics assessment in Southeast Asia (15 articles), with quantitative research dominating the methodologies employed (18 articles). The most prominent research objective is assessment for evaluation purposes (nine articles). Furthermore, junior high school and undergraduate levels are the most researched educational levels (10 articles each). Lastly, the Quizizz application is the most frequently discussed assessment practice in mathematics classrooms in Southeast Asia (two articles). The practical implication of these findings highlights the need for study about topic of assessment as learning in mathematics education. More effort is needed to make prospective teachers and teachers of mathematics utilize technology in assessment in mathematics learning.

## INTRODUCTION

Significant changes in educational assessment have occurred worldwide in recent decades (Van den Heuvel-Panhuizen et al., 2021). The recent assessment trend has migrated from summative to formative assessment (Sudakova et al., 2022). In Indonesia, in the new learning paradigm, educators are expected to focus more on formative assessments than summative assessments and use the results of formative assessments to continuously improve the learning process (Panduan Pembelajaran dan Asesmen, 2021). This implies that in mathematics education, more attention should be paid to fostering students' ability to solve problems, conduct investigations, model problem situations, and communicate mathematical ideas (Van den Heuvel-Panhuizen et al., 2021).

Assessment can be defined as a complex set of activities designed to collect and interpret information essential for improving teaching and learning. (Lim, 2024). Therefore, classroom assessments as part of the teaching and learning process must be interrelated with classroom learning objectives (Maknun et al., 2023) and involve peers or individual learners as agents in making decisions on the assessment (Black & Wiliam, 2009).

Assessments create a tangible footprint of the student's learning journey, providing a basis for learning evaluation, continuous learning, and effective decision-making based on existing data. (Namakshi, 2022). Student learning evidence can be collected through various items such as written works, in-class activities, assignments, class discussions, and so on (Namakshi, 2022). Therefore, it is

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essential for teachers, students, and all partners (stakeholders) to see assessment as proof of improvement in the learning experience.

In addition to having teaching duties, teachers also have a role as evaluators in the learning process (Kusumaningrum & Abduh, 2022). This means that to be said to be a professional teacher, teachers must be able to design assessments that can measure affective (attitude), cognitive (knowledge), and psychomotor (skills) abilities (Munawir et al., 2022). This aligns with the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia, which defines teachers as professional educators responsible for educating, teaching, guiding, mentoring, training, assessing, and evaluating students across formal early childhood, primary, and secondary education (Permendikbudristek Nomor 7, 2024).

Considering the importance of teachers' duties as evaluators in learning, prospective teacher students, especially prospective mathematics teachers, should understand the concept of assessment in learning. The hope is that by studying the concept of assessment in depth, prospective mathematics teacher students can apply it well when they later become teachers.

Research on assessment in general has been carried out by many researchers before, including research conducted by Mahlambi (2021). This research included nine mathematics teachers from an elementary school in Alexandria Township, Johannesburg, Egypt. The findings revealed that teachers have insufficient pedagogical knowledge in utilizing AfL (Assessment for Learning) to enhance active learning in the classroom. They struggle to apply a learner-centered approach that encourages meaningful student engagement in math lessons. As a result, it is recommended that teachers receive ongoing training in classroom time management and planning to implement AfL (Assessment for Learning) effectively.

Ayalon and Wilkie (2020) conduct other research. This study examines the perception of 60 prospective mathematics teacher students in Israel regarding assessing mathematics learning. The findings show that students are beginning to realize the importance of formative assessments and assessments of diverse tasks. However, they also face challenges adjusting to the broader assessment context, including the pressure to meet teacher expectations and work closely with peers.

Along with the development of technology, electronic devices/devices have affected human life in many aspects, including the improvement of electronic devices/devices in the teaching and learning process and assessment (Doğan et al., 2020). Digitalization in the teaching and learning process should accompany digitalization in the assessment process (Ardiana et al., 2021). This is because teachers in the 21st century must have at least three abilities, one of which is assessing learning (assessment) (Gyurova & Zeleeva, 2017).

The above statement is supported by research conducted by Ashari et al. (2023) entitled Application-Based E-Assessment Model in Senior High Schools in the Digital Era: Systematic Literature Review. The findings or results of the study show that relevant E-assessments are applied in high schools because of their skill factors in accessing and operating a variety of existing applications. Digital literacy, owned by the millennial generation, strongly supports the e-assessment process in schools. E-assessment can be developed with several applications, such as Kahoot, quizizz, moodle, and others.

By 2015, the PISA study had switched from paper-based assessment to computer-based assessment as its primary mode of assessment (Nortvedt & Buchholtz, 2018). This is because technology's existence, versatility, and power make it possible and necessary to re-examine what students should learn and how they can best learn mathematics (NCTM, 2000). Therefore, teachers and prospective teachers must look at global education trends, including digital assessments.

The use of E-assessment offers various benefits, including cost savings, faster correction processes, real-time feedback and evaluation results, and the enhancement of digital competencies for both educators and students (Ashari et al., 2023). It also encourages higher-order thinking skills (Alruwais et al., 2018), increases student learning motivation (Nortvedt & Buchholtz, 2018), and also increases students' learning independence (Mahayukti, 2018). So that the proper implementation of E-assessment can make the teaching and learning process more optimal.

However, although information technology provides convenience in assessments, teachers still face many obstacles to using digital-based assessments. One extreme example of this result can be found in Rome, Italy. In Rome, Italy, In the most disadvantaged neighborhoods, the absence of electricity, internet access, and digital devices prevents approximately 70,000 Roma students—

accounting for 11% of the country's youth—from participating in the education system (Amalipe, 2020). The digital divide is widening, with more than 24% of students from 200 Rome-specific schools lacking digital devices, and in a quarter of schools, 20%-50% do not have digital devices (Amalipe, 2020).

Teachers must also consider the adverse impact of such rapid technological developments. Excessive dependence on technology can harm mental and physical well-being and hinder learning ability (Akulwar-Tajane et al., 2020). However, it is important to note that these negative consequences stem from misusing inappropriate technology rather than the technology itself (Akulwar-Tajane et al., 2020).

In addition to the research mentioned above, Jahnke and Liebscher (2020) in his study also suggests that over-reliance on technology could stifle creativity, as students might become less inclined to explore knowledge beyond what is readily available on the internet. Therefore, parents and teachers must continue to educate that information technology is very important for human life today. However, it must be used within reasonable limits and as necessary; otherwise, it will harm the technology users.

The study that have been presented are carried out in several countries. Unfortunately, the trend of research on assessing mathematics learning in one particular region, for example, Southeast Asia, is still limited. Previous research on mathematics assessment practices in the Southeast Asian region has focused more on assessment implementation, assessment for evaluation needs and product development and the use of assessment tools for assessment purposes, but there has been no research that specifically discusses a systematic and up-to-date picture of how mathematics assessment is researched and practiced in Southeast Asia over the past decade. So, the purpose of this research is to find out how the trend of mathematics learning assessment in the Southeast Asian region is, with the following research questions:

RQ1: What types of assessments are used in research related to assessment practices in mathematics learning?
RQ2: What are the research methodologies used in research related to assessment practices in mathematics learning?
RQ3: What research objectives relate to assessment practices in mathematics learning?
RQ4: How are the levels of education distributed in research related to assessment practices in mathematics learning?
RQ5: How is the use of digital technology in assessment and research related to assessment practices in mathematics learning?

## METHODS

This study uses a Systematic Literature Review (SLR) with the PRISMA protocol. Research data was collected from scientific articles on reputable journal websites, namely Scopus and Eric. The journal search process is carried out directly through the Eric Journal database search page, and for the Scopus database, the journal search is carried out with the help of the Publish or Perish application. The keyword used in the search is *"assessment and mathematics education."*

### Eligibility criteria

To determine whether or not the article is suitable for use in research, the researcher sets the inclusion criteria and exclusion criteria as written in Table 1.

### Literature search procedures

The researcher conducted the initial search procedure in the first stage (Identification). This initial search procedure aims to gather suitable articles to answer relevant additional research questions and references. The researcher searched for articles on the Scopus and Eric databases. In the Scopus database, researchers search for articles assisted by the Publish or Perish application. Researchers search for articles in the Eric database directly on the website. The keyword used during the article search is "Assessment in Mathematics Education." In this first stage (Identification), the

**Table 1**
Inclusion and exclusion criteria

| Criteria | Inclusion | Exclusion |
|---|---|---|
| Year | 2015 – 2024 (1 decade) | More than 1 decade |
| Language | English | Other than English |
| Research type | Article journal or proceeding | Other than article journal and proceeding |
| Article | The article discusses assessment practices in Southeast Asian countries | The article does not address assessment practices in Southeast Asian countries |
| | Articles focus on math subjects. | Articles do not focus on math subjects. |

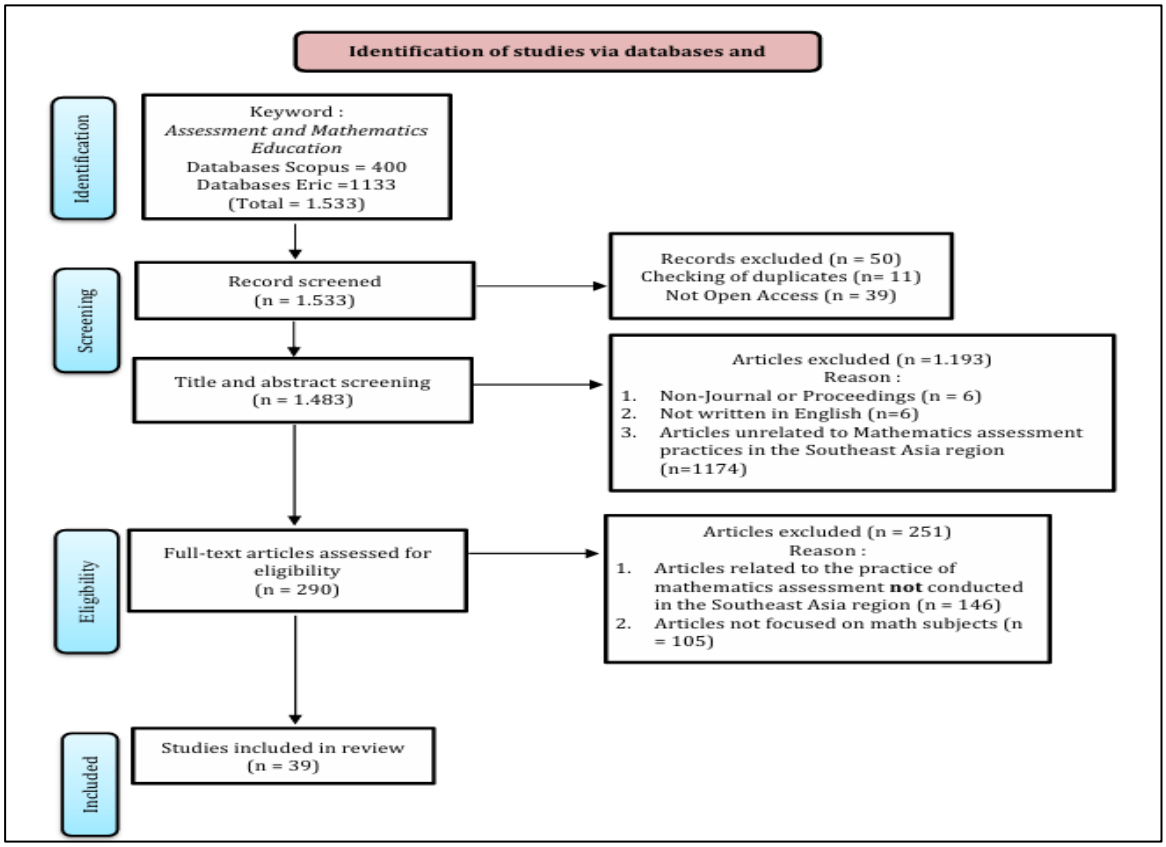


**Figure 1.** Identification of studies via databases and registers

researcher obtained 400 articles on Scopus and 1133 on Eric, so the total number of articles obtained was 1,533.

After the article is obtained, the researcher's next step is the Screening process. First, the researcher checks for article duplication. Based on the researcher's findings, 11 duplicate articles and 39 articles not open access were found, so 50 articles had to be discarded in the first screening process, leaving 1483 articles.

Then, 1483 articles were entered for the second screening process: selection based on title and abstract. At the screening stage, based on title and abstract, 1193 articles were eliminated because 1) 6 articles were not journals or proceedings, 2) 6 articles were not written in English, and 3) 1174 articles were not related to the practice of mathematical assessment in the Southeast Asian region, leaving 290 articles to be included in the Eligibility Criteria stage.

After the screening process, the researcher continued with the screening process based on the Eligibility Criteria. At this stage, out of the remaining 290 articles, 251 were eliminated for the following reasons: 1) 146 articles were not conducted in Southeast Asia, and 2) 105 articles were not conducted in the Southeast Asian region. So, the final articles used for this research are 39 articles, which can be seen in more detail in Figure 1.

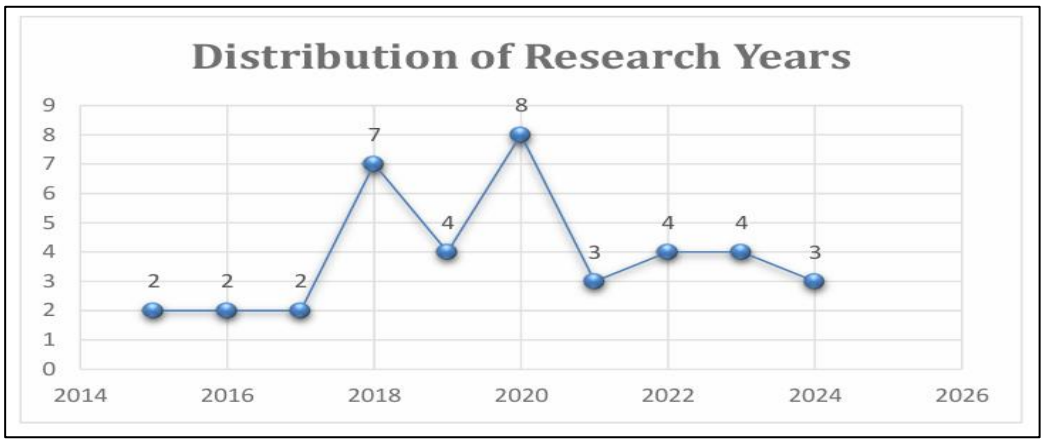


**Figure 2.** Distribution of research years

## Data analysis

After a screening process that resulted in 39 final articles, data analysis was carried out systematically. The process of extracting and categorizing relevant data from each article follows the set of research questions (RQ) that have been determined, as follows: a) First, the articles were grouped by year of publication to identify the distribution of the research year of the article, the results of which are then presented in Figure 2, b) Second, articles are classified based on the country where the research was conducted to find out the map of the distribution of articles in the Southeast Asian region, the results of which are then presented in Figure 3, c) To answer RQ1, the articles were categorized based on the type of assessment discussed in the article. The data to answer RQ 1 are then presented in Table 2 and visualized in Figure 4, d) To answer RQ2, the research methodology used in each article was identified and grouped. The results of the grouping of research methods are presented in Table 3 and visualized in Figure 5, e) To answer RQ3, the research objectives of each article were analyzed and then classified into 9 categories as shown in Table 4. In addition, the researcher also analyzed the research objectives and research methodology used from each article whose results are presented in Table 5, f) To answer RQ4, the articles were grouped based on the level of education that became the focus of the research. After that, the distribution of education levels for each article is illustrated in Figure 6, g). To answer RQ5, the use of digital technology in assessment practices in each article was analyzed and recorded in detail. The findings are summarized in Table 6. This process of grouping and categorization is done manually with the help of Microsoft excel to ensure accuracy and ease in organizing the data, which then becomes the basis for the presentation of results and discussions.

## FINDINGS

In this study, as many as 39 articles were analyzed. The articles consist of 33 (85%) journal articles and 6 (15%) proceedings from 2015-2024, with the annual acquisition of articles listed in Figure 2. Figure 2 shows that the number of articles was relatively stagnant, namely two articles, from 2015 to 2017. Then, it increased significantly from 2018 to 2020. However, it dropped significantly in 2021, with the total data on the number of articles obtained by each country listed in Figure 3.

The overview of the distribution of articles in Figure 3 explains that Indonesia is the most significant contributor of articles with 18 articles, followed by Malaysia with nine articles, Thailand with four articles, the Philippines with three articles, Vietnam with two articles, Singapore and Brunei Darussalam with 1 article each and finally Timor Leste, Laos, Cambodia, and Myanmar with zero articles each. So, the total number of articles is 39. Furthermore, from the 39 articles, answers to research questions are obtained as follows:

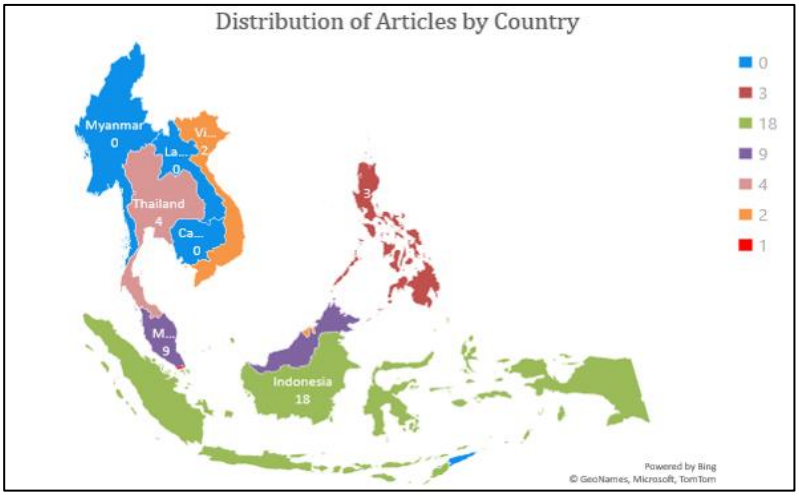


**Figure 3.** Distribution of articles by country

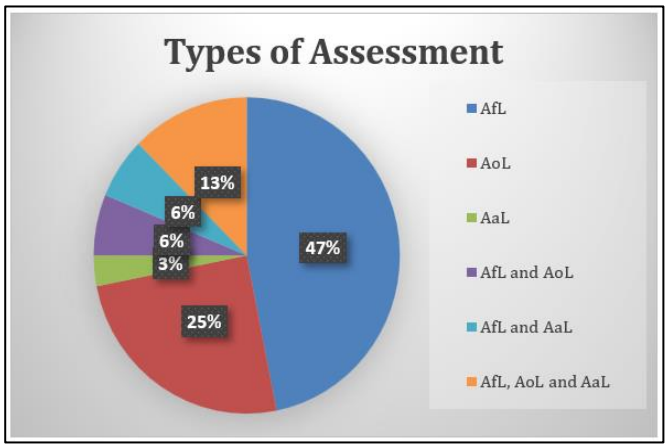


**Figure 4.** Types of assessment

**Table 2**
Types of Assessments

| No | Types of Assessments | Number of Articles |
|---|---|---|
| 1 | Assessment for Learning | 15 |
| 2 | Assessment of Learning | 8 |
| 3 | Assessment as Learning | 1 |
| 4 | Assessment for Learning and Assessment of Learning | 2 |
| 5 | Assessment for Learning and Assessment as Learning | 2 |
| 6 | Assessment for Learning, Assessment of Learning, and Assessment as Learning | 4 |

**RQ 1: What assessment is used in research on assessment practice in mathematics learning?**

Assessment based on its function can be divided into three types: Assessment of Learning, Assessment for Learning, and Assessment as Learning (Budiono & Hatip, 2023). Assessment of Learning (Summative Assessment) is an assessment that aims to validate learning and reports for parents and students about student progress in school (Earl, 2003); assessment for Learning (AfL) is an assessment designed to make each student's understanding and knowledge "visible" (Hattie, 2012), so that teachers can decide what they can do to help students progress (Magbeyi et al., n.d.). Examples of this Assessment for Learning are Formative and Diagnostic assessments (Panduan Pembelajaran dan Asesmen, 2021). Meanwhile, Assessment as Learning (AaL) occurs when students act as assessors for themselves. There are two types of Assessment as Learning (AaL): Self-Assessment and Peer-Assessment (Panduan Pembelajaran dan Asesmen, 2021).

**Table 3**
Research method

| Type of Research | Research Methods | Number of Article | Total |
|---|---|---|---|
| Qualitative | Not Mentioned | 4 | 16 |
| | Case Studies | 5 | |
| | Curriculum Analysis | 1 | |
| | Exploratory Descriptive | 2 | |
| | Qualitative Descriptive | 2 | |
| | Authentic Approach | 1 | |
| | Phenomenologies | 1 | |
| Quantitative | Method Acidic | 1 | 18 |
| | Pretest-Posttest Control Group Design | 1 | |
| | Research and Development (R&D) | 5 | |
| | Not Mentioned | 7 | |
| | Quantitative applied research methods | 1 | |
| | Quasi-Experimental | 2 | |
| | Quantitative descriptive | 1 | |
| Mix Method | Mix Method | 4 | 5 |
| | Educational Design Research (EDR) | 1 | |

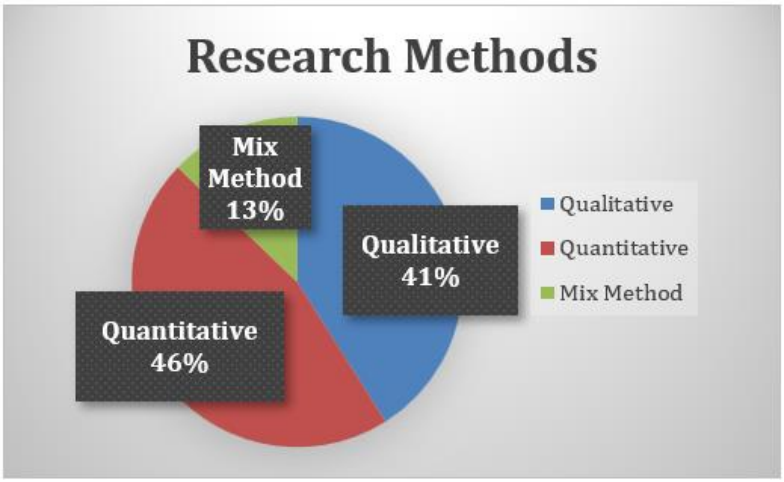


**Figure 5.** Research methods

Based on this classification, the researcher divided the classification of types of assessments into six parts, as shown in Table 2. So, based on Table 2, the percentage of each type of assessment is obtained, as shown in Figure 4. Based on the percentage of the types of assessments in Figure 4, it can be known that Assessment for Learning (AfL) is the most researched assessment in the Southeast Asian region, with 15 articles (47%) of the total. Of the 15 Assessment for Learning articles, 10 discuss formative assessment, with five from Indonesia. These findings confirm the opinion of Sudakova et al. (2022), Which states that "The recent assessment trend has migrated from summative assessment to formative assessment."

**RQ 2: What are the research methodologies used in research related to assessment practices in mathematics learning?**

Based on Table 3, the type of qualitative research gets as many as 16 (41%) articles, the type of quantitative research gets as many as 18 (46%), and the mixed method gets as many as 5 (13%) articles. So, the most widely used type of research is quantitative research, with as many as 18 (46%) articles, which can be seen more clearly in Figure 5.

**Table 4**
Research objectives

| No | Classification | Number of Articles |
|---|---|---|
| 1 | Student and teacher perceptions of online assessments | 3 |
| 2 | Impact of Assessment | 6 |
| 3 | Assessment for evaluation purposes | 9 |
| 4 | Assessment Implementation | 10 |
| 5 | Product development and use of assessment tools for assessment purposes | 7 |
| 6 | Readiness of mathematics teachers in carrying out assessments in the classroom | 1 |
| 7 | Knowledge of HOTS question patterns for assessment purposes | 1 |
| 8 | Analysis of the need for assessment tools | 1 |
| 9 | Efforts to improve teachers' ability to carry out assessments in the classroom | 2 |
| **Total** | | **39** |

**Table 5**
Types and objectives of research

| No | Type of Research | Research Objectives | Number of Articles | Total |
|---|---|---|---|---|
| 1. | Mix Method | Student and teacher perceptions of online assessments | 1 | 5 |
| | | Impact of Assessment | 2 | |
| | | Assessment for evaluation purposes | 1 | |
| | | Efforts to improve teachers' ability to carry out assessments in the classroom | 1 | |
| 2. | Qualitative | Student and teacher perceptions of online assessments | 1 | 16 |
| | | Impact of Assessment | 1 | |
| | | Assessment for evaluation purposes | 5 | |
| | | Assessment Implementation | 7 | |
| | | Knowledge of HOTS question patterns | 1 | |
| | | The need for collaborative assessment tools | 1 | |
| 3. | Quantitative | Student and teacher perceptions of online assessments | 1 | 18 |
| | | Impact of Assessment | 2 | |
| | | Assessment for evaluation purposes | 3 | |
| | | Assessment Implementation | 4 | |
| | | Product development and use of assessment tools for assessment purposes | 6 | |
| | | Readiness of mathematics teachers in carrying out assessments in the classroom | 1 | |
| | | Efforts to improve teachers' ability to carry out assessments in the classroom | 1 | |

**RQ 3: What research objectives relate to assessment practices in mathematics learning?**

Table 4 shows that articles that aim for evaluation are trending in assessment research in the Southeast Asian region, with as many as nine articles. In contrast, articles that discuss the readiness of mathematics teachers in carrying out assessments in the classroom, knowledge of HOTS question patterns, and analysis of the need for assessment tools are still very minimal, with 1 article each. Then, if the research objectives are related to the type of research, the results are obtained in Table 5.

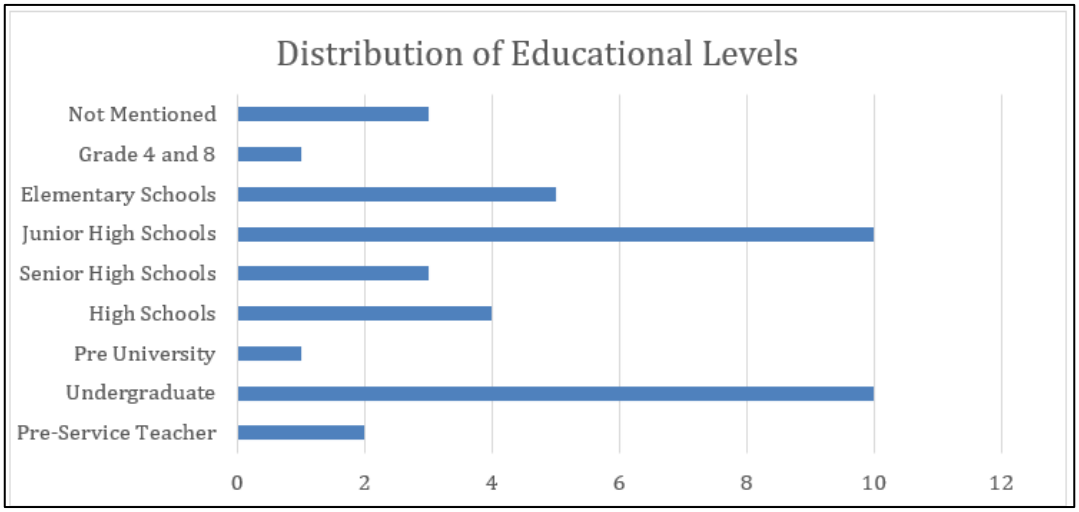


**Figure 6.** Distribution of educational levels

Based on Table 5, we know that research that discusses the impact of assessment is widely used in the mixed method (as many as two articles), qualitative research is widely used to determine the implementation of assessment (7 articles), and in quantitative methods, the development of products/instruments for assessment is a widely used research objective (6 articles).

**RQ 4: How are the levels of education distributed in research related to assessment practices in mathematics learning?**

Figure 6 shows that Junior High Schools and Undergraduate education are the most researched educational levels in Southeast Asian countries.

**RQ 5: How is digital technology used during learning practice in mathematics classrooms?**

Based on the systematic literature review, eight articles discuss the form of technology utilization for assessment purposes. Some of the technologies discussed in the article found by the researcher are shown in Table 6.

## DISCUSSION

### The popularity of assessment in mathematics learning

The study's findings show that Assessment for Learning, especially formative assessment, is the most researched in the Southeast Asian region. This is because, according to Black and Wiliam (2009), Formative assessment consists of five key strategies: a) Defining and communicating learning objectives and success criteria; b) Facilitating meaningful classroom discussions and tasks that showcase student comprehension; c) Offering feedback that helps students progress; d) Encouraging students to teach one another; and e) Empowering students to take ownership of their learning. Therefore, formative assessment should be thoroughly studied and implemented in education.

However, teachers still face many challenges in implementing formative assessments in Southeast Asia. An example is Timor Leste, a country. Research conducted by Costa Akoyt (2024) against 50 primary school teachers in Timor Leste shows that 92% of teachers agree with the statement, "I believe that formative assessment can promote learning, and I want to learn more about formative assessment practices." However, of the 50 teachers, 56% claimed that they rarely used formative assessments in their classrooms. In addition to formative assessments, another large percentage, 82% of teachers, also reported that they rarely use peer assessment and self-assessment in their classrooms.

In Myanmar, research conducted by Oo et al. (2024) found a need to improve assessment literacy among Myanmar teachers. This is because teachers in Myanmar still have limited knowledge

**Table 6**
Forms of technology utilization

| No | Types of Technology | Forms of Technology Utilization | Country | Number of articles that discuss |
|---|---|---|---|---|
| 1. | Learning Management System (LMS) | a. A place to manage various learning activities, including online assessments.<br>b. A place to collect data systematically.<br>c. Allows assignments to be more interactive and increases student engagement in completing assignments.<br>d. Allows for more flexibility in where and when tasks are done.<br>e. Allows for quick and constructive feedback. | Philippines | 1 |
| 2. | Desktop-based applications built using the Delphi programming language | a. A place to systematically collect and organize data.<br>b. This is for students' reflections and revisions, as a private comment feature about students' work is available.<br>c. For online assignment assessments.<br>d. Analysis of learning progress data and the effectiveness of learning methods. | Indonesia | 1 |
| 3. | A statistical textbook model designed using information and communication technology (ICT) and a Portfolio-Based Assessment approach | Providing students with opportunities to understand statistical data analysis in more depth will bring this book closer to the real world and make it easier for students to connect theory with practice. | Indonesia | 1 |
| 4. | Quizizz | a. Simplify the implementation of assessments<br>b. Accelerate feedback to students<br>c. Increasing learning creativity, including assessment. | Malaysia and Indonesia | 2 |
| 5. | Google Forms integrated with IATA software | a. Collecting feedback from students<br>b. Assessment of student achievement<br>c. Analysis of student achievement results | Vietnam | 1 |
| 6. | Quick Response Code (QR-Code) | a. Quick access to subject matter<br>b. Data collection and feedback | Indonesia | 1 |
| 7. | Exelsa | a. In this study, the Exelsa application is used to manage and conduct the peer assessment process technologically. Exelsa allows students to give feedback on their classmates' work in a more structured and efficient way.<br>b. This application also supports data collection and student reflection. | Indonesia | 1 |
| | | **Total** | | 8 |

related to assessment. They said the purpose of conducting assessments is to measure student learning outcomes, not to improve the teaching and learning process in the classroom (Lim, 2024).

Research in Vietnam by Le (2021) involving 579 junior and senior students majoring in basic education at 11 universities in Vietnam concluded that the capacity for formative assessment in teaching mathematics in elementary school departments is still limited. These limitations are mainly

**Table 7**
Average PISA score (OECD, 2023)

| Rank | Country | Average PISA Score (Average OECD = 472) | Number of paper about assessment in mathematics |
|---|---|---|---|
| 1. | Singapore | 575 | 1 |
| 2. | Vietnam | 469 | 2 |
| 3. | Brunei Darussalam | 442 | 2 |
| 4. | Malaysia | 409 | 9 |
| 5. | Thailand | 394 | 4 |
| 6. | Indonesia | 366 | 18 |
| 7. | Philippines | 355 | 3 |
| 8. | Cambodia | 336 | 0 |

limitations on the understanding of methods, tools, and forms of formative assessment in teaching mathematics in elementary schools. Based on some of these studies, the knowledge and skills of teachers and prospective teachers, especially in mathematics education in the Southeast Asian region, must be improved.

Meanwhile, research related to Assessment as learning is the least researched research in research related to assessment in mathematics learning in Southeast Asia. In fact, assessment as learning is an assessment that aims to enable students to become independent students and requires students to be aware of what is required of them and monitor and evaluate their own learning during the learning process (Yan & Boud, 2022). So that with the information obtained, they can organize their learning to achieve the goals they have set in advance (Yan & Boud, 2022). Therefore, because this assessment as learning is an important assessment to be carried out by teachers and students of prospective mathematics teachers. Therefore, mathematics teachers and prospective mathematics teacher students are expected to be able to have the knowledge and skills to carry out the assessment of learning in mathematics classes.

## The popularity research methodologies in mathematics learning

The type of quantitative research is also the most researched by researchers in the Southeast Asian region, with 19 articles, of which seven articles aim to develop products and use assessment tools for assessment purposes. The development and assessment tools used include: a). Development of statistics textbooks supported by ICT and portfolio assessment (Hendikawati, 2016); b). Leveraging Google Forms with IATA software (Hau, 2020); c). Development of *Assessment for Learning* Humanistic model (AfL-H) (Winarno et al., 2019); d). Development of assessment instruments using polytome responses (Sutiarso et al., 2022); e). Development of numeracy test instruments for Minimum Competency Assessment (MCA) (Purnomo et al., 2022); f). Development of a Diagnostic Cognitive Assessment Tool to assess students' mastery of the concept of "Parallel and Straight Tegal" lines (Chin et al., 2022); and finally, g). Development of statistical thinking frameworks and assessment tools that involve statistical thinking (Hooi Lian & Yew, 2023).

## The popularity education level in mathematics learning

Regarding the level of education, we all know that junior high school and undergraduate are the levels of education that are widely studied about the assessment of mathematics classes in the Southeast Asian region, with 10 articles each. At the junior high school level, assessment for evaluation is the most studied research objective, consisting of four articles. Undergraduate research to find out the perception of students and teachers related to assessment is the most studied research objective, with as many as four articles.

An interesting study from Indonesia is worth discussing, according to the researcher. This research was conducted by Khaira (2020). This study was conducted at a Junior High School to explore how teachers support students, the role of teachers in assisting slow learners in mathematics, and the challenges faced by these students. One key issue slow learner encounter is the lack of opportunities to solve problems in front of the class. Additionally, they struggle to keep up with their peers due to slower comprehension and learning processes and face time constraints during class lessons. A potential solution for educators or future educators is the implementation of

clinical teaching. This approach involves a tailored learning assessment to assist students with learning difficulties (KTSP, 2009). Clinical teaching aims to tailor students' learning experiences to the unique needs of students who experience learning difficulties. In other words, this clinical teaching ensures that all learners, including those needing more time, can achieve the necessary clinical competencies and feel supported throughout their educational journey.

### Number of articles compared to the average PISA score

Another interesting thing that the researcher found is, based on PISA data in Table 7. The countries of Indonesia, Malaysia, Thailand, the Philippines, Vietnam, and Brunei Darussalam, which have more articles related to assessments in mathematics classes, still have a lower average PISA score compared to Singapore, which only has 1 article. This shows that many or few articles related to assessments have not fully demonstrated the level of assessment quality in the country. There may be other factors that have an impact as well.

If we want to compare Southeast Asian countries with China, which has a lower OECD average than Singapore (with an average OECD score of 552). The average score of OECD countries such as Vietnam, Brunei Darussalam, Malaysia, Thailand, Indonesia, the Philippines and Cambodia is still quite far behind. This is because in China, the use of technology for assessment purposes is also quite good, for example in research conducted by Chen et al. (2020).They have used interactive whiteboards as one of the technologies to carry out formative assessments.

### The popular of digital technology used during learning practice in mathematics classrooms

Of the 39 articles studied in this study, there are only 8 articles that discuss digital technology used to support the practice of mathematics assessment in the Southeast Asian region. Countries that discuss technology to support the practice of mathematical assessment are the Philippines, Indonesia, Malaysia, Vietnam and the most widely used digital media to support assessment practice is Quizizz which is discussed in 2 articles out of 39 articles namely research conducted by Saleh and Sulaiman (2019) and Rahman et al. (2019). Therefore, more research discusses digital technology used to support the practice of mathematics assessment in the Southeast Asian region and more effort is needed to make prospective teachers and teachers of mathematics to utilize technology in assessment in mathematics learning.

### Suggestions for future research

Based on the results of the above research, the research gap for researchers in the future is as follows:

1. Research related to assessment as learning is the least researched assessment in articles that discuss assessment in the Southeast Asian region. Therefore, research related to assessment as learning is needed as a reference for teachers and prospective teacher students in designing assessment as learning
2. More effort is needed to make prospective teachers and teachers of mathematics utilize technology in assessment in mathematics learning. Therefore, more research related to the use of technology in supporting digital assessments is needed as a reference for teachers and prospective students in designing digital assessments.

## CONCLUSION

Based on the research and discussion results, several things can be concluded in this study: 1) Assessment for Learning (AfL) is the most studied assessment topic in Southeast Asian countries, with 15 articles. Of the 15 articles, 10 discuss formative assessments, and of the 15 articles, five are from Indonesia. Assessment for Learning (AfL) is one of the most fundamental assessments in the classroom. Through this Assessment for Learning (AfL), teachers can discover things that must be improved during learning. 2) Quantitative research is a research methodology that dominates articles related to mathematical assessment in the Southeast Asian region, with a total of 18 articles and seven articles discussing the development of products/instruments for assessment. 3) Assessment for evaluation is the most dominating research objective in articles related to mathematics assessment in the Southeast Asian region, with as many as nine articles. 4) Junior high school and undergraduate education levels are the most studied levels of education in research related to mathematics assessment in the Southeast Asian region, with each level discussed in 10

articles. 5) The Quizizz application is the most widely used assessment practice in mathematics classes in the Southeast Asian region, with two articles that discuss the application. The practical implication of these findings highlights the need for study about topic of assessment as learning in mathematics education. More effort is needed to make prospective teachers and teachers of mathematics to utilize technology in assessment in mathematics learning.

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## AUTHOR'S DECLARATION

| | |
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