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Construct validation of a mathematical disposition instrument using exploratory factor analysis (EFA)

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Abstract

The classroom learning process is inseparable from student assessment activities, which include cognitive, affective, and psychomotor aspects. Mathematical disposition, as one of the essential components of the affective domain, plays a significant role in supporting students' success in learning mathematics. Given its importance in enhancing engagement, motivation, and learning outcomes, a valid and reliable instrument is required to measure it accurately. This study aims to conduct construct validation of a mathematical disposition instrument. A quantitative method was employed using Exploratory Factor Analysis (EFA) to demonstrate the construct validity and reliability of the assessment tool. The instrument was developed based on four main aspects synthesized from various theoretical frameworks and previous studies, namely (1) confidence, (2) persistence and perseverance, (3) interest and curiosity, and (4) flexible thinking. The instrument was administered to 440 respondents across four senior high schools in Pekalongan City, Central Jawa, Indonesia. The empirical data were analyzed using the R software to obtain the EFA results. The findings show that the instrument demonstrated excellent sampling adequacy, with a KMO value of 0.874 and a significant Bartlett's Test of Sphericity (p = 0.000), indicating that the data met the requirements for factor analysis. The EFA results yielded four main factors with a total explained variance of 46.460% after rotation, namely Affective Engagement in Mathematics, Flexible Mathematical Problem-Solving, Mathematics Avoidance and Helplessness, and Self-Regulated Mathematics Learning. Based on these findings, the mathematical disposition instrument is considered valid and appropriate for accurately and comprehensively assessing senior high school students' mathematical disposition.

Keywords

Exploratory factor analysis, Mathematical disposition, Instrument, Construct validity

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Introduction

The learning process in the classroom cannot be separated from the assessment of students, which encompasses three main aspects: cognitive, affective, and psychomotor [1]. One of the affective aspects that has become an important focus in mathematics education is mathematical disposition [2]. The affective aspect plays a significant role in determining students' success in particular subjects, including mathematics [1]. Mathematical disposition significantly influences students' learning process as it encompasses beliefs or tendencies that are reflected through consistent, conscious, and voluntary behavior in learning mathematics [3,4]. Research shows that success in mathematics learning has a close relationship with mathematical disposition [5]. In the context of students, mathematical disposition is reflected in attitudes of appreciating the usefulness of mathematics in life, curiosity, interest in learning, perseverance, and confidence in solving mathematical problems [6].

Mathematical disposition is also understood as an internal attitude that includes desire, ambition, concern, dedication, and the tendency to reason and maintain a positive attitude toward mathematics throughout the learning process [5,7,8]. The more positive a student's mathematical disposition, the greater their opportunity to succeed and be active in mathematics learning [8,9]. Conversely, negative mathematical disposition is not always caused by low mathematical ability, but rather can be influenced by students' poor perception of mathematics [10]. Students with high disposition tend to be more proficient in translating information into visual representations as well as using written text to solve problems.

Mathematical disposition becomes an important tool for measuring students' interest in learning mathematics and plays a role in the smoothness of the learning process, as it helps students enjoy learning activities, understand the benefits of mathematics, and apply it in daily life [8]. Mathematical disposition also functions as a connector in mathematics learning [11] and enables teachers to evaluate students' confidence and motivation in learning mathematics [12]. Disposition applies not only to students, but also to teachers and prospective teachers who have the responsibility to teach mathematics professionally [13,14]. Therefore, the role of teachers is very important in determining learning approaches that are capable of fostering students' enthusiasm for learning, which ultimately affects their mathematical disposition [11]. Considering this significance, teachers have a great responsibility in cultivating productive mathematical disposition.

Teachers are required to transform students' mathematical disposition from negative to positive so that they believe in the benefits of mathematics both in problem-solving and in future career development [10]. Active student engagement in learning contributes to the improvement of mathematical disposition [15]. In Indonesia, students with low disposition tend to demonstrate limited mathematical abilities, while those who have high disposition show better proficiency [12]. The perception that mathematics is a difficult subject often impacts low learning outcomes, thus contributing to the weakness of students' mathematical disposition. Various studies have found that students' mathematical disposition is still in the low category [16].

Indicators of mathematical disposition have been formulated by various experts. In this regard, NCTM [17] identified seven indicators: confidence, flexibility, perseverance, curiosity, reflective ability, appreciation, and valuing. Another perspective on mathematical disposition [12] proposed different indicators: confidence, flexibility, usefulness, perseverance, curiosity, appreciation, and metacognition. Additionally, another viewpoint [18] emphasized indicators such as self-confidence, perseverance, flexibility and open-mindedness, interest and curiosity, as well as the ability to monitor thinking processes. Furthermore, [19] added elements of enthusiasm, unwillingness to give up, high curiosity, and willingness to share. Based on these various perspectives, this study established four core aspects of mathematical disposition: confidence, persistence and perseverance, interest and curiosity, as well as flexibility of thinking. These four aspects were further developed into assessment indicators for students' mathematical disposition.

Assessment conducted during learning plays an important role in determining students' success. Good assessment must be able to provide accurate information regarding mathematical disposition, which can be achieved, among other ways, through comprehensive item analysis [20]. In this context, construct validity becomes a crucial aspect to ensure that the instrument truly represents the mathematical disposition construct to be measured. Empirical evidence can be obtained by using EFA analysis, which is used as an initial diagnostic approach in identifying the latent structure behind a collection of statement items. The suitability of data for EFA is assessed comprehensively through two criteria: 1) KMO value which should be above 0.5, and 2) Bartlett's Test of Sphericity with a significant value of less than 0.05 [21]. This means that both must be met to indicate that the empirical data are suitable for EFA.

EFA analysis will determine the number of factors formed; data that converge will bind together into one and form a factor name. The determination of the number of factors to be extracted uses parallel analysis, a more contemporary approach that is considered superior to the outdated Kaiser criterion [22]. The decision on the number of factors also considers the identification of inflection points on the screen plot and eigenvalues [23]. The calculation of eigenvalues reflects the magnitude of variance contribution of each item to a particular factor [24]. The percentage of total variance explained by each factor is calculated by dividing the eigenvalue by the total number of items analyzed [24]. In addition, construct reliability Omega also needs to be considered [25]. Reliability is used to examine the consistency of the instrument in measuring students' abilities.

There have been many studies focusing on mathematical disposition. Quantitative studies related to mathematical attitudes and disposition tend to use analytical techniques such as latent class analysis [26], and regression modeling [10,27]. In addition, research on mathematical disposition modeling [28,29], and path analysis related to mathematical disposition [30]. Qualitative studies on mathematical attitudes and disposition [11,31]. Mixed method studies examined the level of mathematical disposition of prospective elementary school teachers [7]. Interestingly, in line with research that will review the urgency of mathematical disposition, none of the instruments used have fully reported on construct validity using EFA.

Based on recent literature review, there is a gap in the psychometric analysis of mathematical disposition instruments. Although there have been several studies explaining mathematical disposition, none have specifically conducted EFA to determine how many factors are formed along with their factor names. The novelty of this research lies in the use of EFA to define what aspects constitute the latent variable of mathematical disposition based on empirical data involving four schools in Pekalongan City, Central Jawa, Indonesia. The results of this study are expected to generate understanding regarding the construct-validated factors forming mathematical disposition that can be used as a reliable measurement tool for educators

Method

This research is a study with a quantitative approach using Exploratory Factor Analysis (EFA) as the data analysis technique. The mathematical disposition instrument was administered to 440 high school students in Pekalongan City, Central Java, Indonesia, consisting of four schools. The scoring rubric for the mathematical disposition instrument uses four categories: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) (Table 1).

Table 1. Mathematical disposition assessment technique

Favorable	Score	Unfavorable	Score
Strongly Agree (SA)	4	Strongly Agree (SA)	1
Agree (A)	3	Agree (A)	2
Disagree (D)	2	Disagree (D)	3
Strongly Disagree (SD)	1	Strongly Disagree (SD)	4

The developed instrument has undergone a content validity stage involving 5 raters, namely two psychological measurement experts and three mathematics education lecturers. The assessment results calculated using the V-Aiken formula obtained a holistic score of 0.897 with a very valid category. The instrument statement items were developed from four indicators: 1) confidence, 2) persistence and perseverance, 3) interest and curiosity, and 4) flexibility in thinking. The instrument blueprint that has been developed and has undergone the content validity stage can be seen in Table 2.

After the instrument is tested and empirical data are obtained, the data will then be analyzed using construct validity. Construct validity with EFA analysis will check the KMO value, which should be above 0.5, as well as Bartlett's Test of Sphericity with a significant value of less than 0.05. The significance value in Bartlett's Test of Sphericity must be less than the error level (α); this test is used to examine sample adequacy. Furthermore, in order for items to proceed to factor analysis, all items must have an anti-image correlation value > 0.5 [32]. The number of factors formed will be identified by examining eigenvalues with the requirement of being greater than 1. Factor rotation is also important in EFA analysis; factor rotation plays a role in determining the position of items on the formed factors, with the requirement that factor loading values > 0.4 [33]. Then, construct reliability is tested using the Omega (ω) formula, where the Omega value is generally considered reliable if it reaches 0.70 [34]. This category serves as the basis for determining the reliability criteria for Omega and Composite Reliability.

Table 2. Mathematical disposition instrument blueprint

Indicators	Characteristics	Statement Polarity	Item
Confidence	Learning mathematics with confidence	Positive	15
		Positive	12
		Positive	9
		Negative	19
	Mathematics tasks can be completed with confidence	Positive	17
		Positive	5
	Confident in using mathematics to solve problems	Positive	4
		Negative	7
Persistence and Perseverance	Perseverance in working on mathematics tasks	Positive	11
		Positive	21
		Negative	22
	Persistence in seeking alternative solutions in solving mathematical problems	Positive	14
		Negative	8
Interest and Curiosity	Demonstrating interest in mathematics	Positive	3
		Positive	1
		Negative	10
		Positive	23
	Showing serious attention in learning	Positive	13
		Negative	18
Flexibility in Thinking	Flexible in exploring and investigating mathematical ideas	Positive	24
		Negative	2
		Positive	20
		Positive	16
		Negative	6

Results

The results of this study will be discussed in sub-sections, namely the suitability of data for EFA, the results of Exploratory Factor Analysis, and the results of construct reliability estimation. Empirical data were obtained from 440 respondents. The results of this study are presented in the following sub-sections.

Suitability of data for EFA

Before conducting EFA, the suitability of empirical data was first tested. Instrument analysis in educational research must meet technical requirements so that measurement results can be justified [35]. After conducting data analysis with the R program, the Kaiser-Meyer-Olkin (KMO) value obtained was 0.874 with a meritorious category. This means that the correlations between items are considered adequate for conducting EFA analysis. This is in line with the statement by [36] that a good instrument must demonstrate statistical sample adequacy.

Bartlett's Test of Sphericity analysis using the R program software yielded a significance value of p = 0.000. This means that the correlation matrix is not in the form of an identity matrix and the variables are significantly correlated with each other. This condition is a prerequisite that must be met before factor analysis is conducted [37]. A summary of the analysis results using the R program software can be seen in Table 3.

Table 3. Results of KMO and bartlett's test

Statistic	Result
Keiser-Meyer-Olkin (KMO)	0.874
Bartlett's Test of Sphericity Sig.	0.000

Checking the Measure of Sampling Adequacy (MSA) value is also necessary; the MSA values from the analysis ranged from 0.658 to 0.943. This means that there were no items dropped based on the minimum requirement of 0.5. The MSA value is used to examine the suitability of mathematical disposition items individually. This finding indicates that all items meet the suitability requirements to proceed with EFA and support the fulfillment of the empirical validity foundation of the instrument [1]. Then, the communalities values can be observed as information about the ability of items to explain factors; statement items that have extraction values > 0.4 can explain factors [38].

Based on the communality's values, all items have extraction values > 0.4 (range: 0.441-0.773), indicating adequate contribution to the factor structure. Overall, the results show that the extracted factors are capable of explaining most of the variance from the items in the instrument with an acceptable level of adequacy.

Results of exploratory factor analysis

Eigenvalues will serve as a reference in determining factors based on empirical data analyzed using EFA. The test was conducted with 24 components, and a factor will be formed if it has an eigenvalue > 1 [39]. Initial analysis yielded six components with eigenvalues above 1 and a total variance explained of 58.768%. Eigenvalues and variance percentages can be seen in Table 4.

Table 4. Eigenvalues and Variance Percentages

Component	Eigenvalue	Rotation Sums of Squared Loadings	
		Variance	Cumulative
1	6.922	14.848	14.848
2	2.102	11.176	26.023
3	1.685	10.890	36.913
4	1.331	9.547	46.460
5	1.057	6.418	52.878
6	1.008	5.889	58.768

Factor 1 is capable of explaining 14.848% of the total variance, factor 2 has a contribution of 11.176%, factor 3 amounts to 10.890%, factor 4 has an influence of 9.547%, factor 5 explains 6.418%, and factor 6 contributes 5.889% of the total variance. If we examine the cumulative column in Table 4, the six existing factors are capable of explaining 58.768%

of the total variance, while 41.232% is explained by other factors. The formation of six factors can also be observed in the scree plot diagram from the analysis using the R program, which is shown in Figure 1.

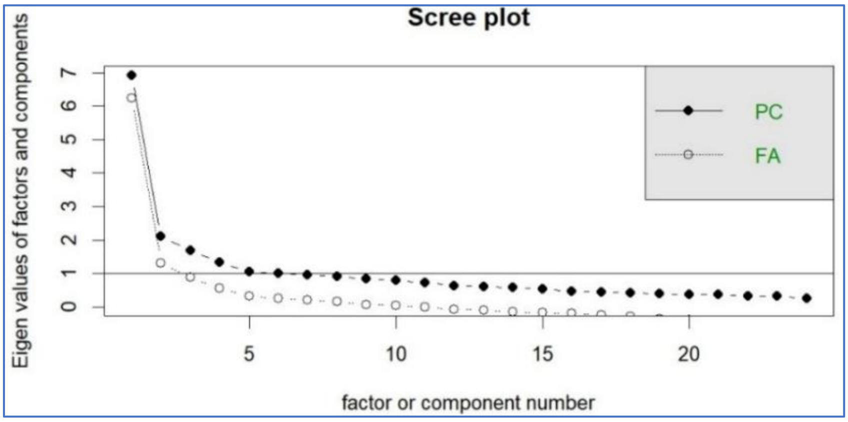

Figure 1. EFA scree plot

Based on Figure 1, it shows a steep scree plot pattern on the first factor and begins to level off on the second factor and beyond, and there are six points above the eigenvalue > 1. This proves that there is only one factor or the most dominant factor, namely mathematical disposition [39]. Then we need to examine the rotated component matrix presented in Table 5 to observe the items forming the factors from the EFA analysis results.

Table 5. Rotated component matrix

Component	1	2	3	4	5	6
Item_3	0.719	0.175	0.100	0.238	0.079	0.090
Item_9	0.669	0.087	0.109	0.301	0.234	0.079
Item_12	0.610	0.307	0.260	0.158	-0.028	0.183
Item_4	0.575	0.158	0.237	0.131	0.108	0.015
Item_20	0.571	0.132	-0.075	-0.225	-0.028	0.480
Item_23	0.571	0.205	-0.015	0.362	0.117	-0.230
Item_17	0.547	0.305	0.264	0.230	-0.084	-0.073
Item_14	0.086	0.736	-0.109	0.018	0.237	0.085
Item_16	0.171	0.709	0.048	0.172	-0.108	-0.235
Item_13	0.187	0.651	0.176	0.211	0.013	0.071
Item_15	0.391	0.576	0.162	-0.044	0.215	-0.046
Item_24	0.305	0.446	0.199	0.291	-0.125	-0.305
Item_21	0.215	0.427	0.279	0.146	0.163	0.350
Item_22	-0.032	0.201	0.710	0.139	0.190	-0.123
Item_8	0.359	0.001	0.682	0.044	0.098	0.028
Item_7	0.357	-0.008	0.667	-0.025	0.117	0.188
Item_6	0.030	0.090	0.666	0.092	0.062	0.103
Item_11	0.220	0.085	0.067	0.834	0.088	0.104
Item_5	0.218	0.160	0.101	0.793	0.043	0.124
Item_1	0.362	0.260	0.127	0.491	-0.038	-0.138
Item_10	0.012	0.051	0.104	0.080	0.815	-0.017
Item_19	0.252	0.162	0.322	0.072	0.594	0.087
Item_2	0.110	-0.096	0.314	0.118	0.045	0.657
Item_18	0.141	0.050	0.320	-0.252	0.441	-0.495

Besed on Table 5, we can determine the items forming a factor if the item has a factor loading value > 0.4 [33]. However, the decision on the number of factors is not solely determined by eigenvalues, but also considers construct interpretability and factor stability [22,23,40]. In addition, a refinement process is necessary if there are factors with too few items or are unstable [41]. Based on conceptual analysis and item loadings, the factor structure that was initially six factors was simplified into four main factors, which are more theoretically consistent [20]. The final factor composition of the mathematical disposition instrument can be seen in Table 6.

Table 6. Final factor composition of the mathematical disposition instrument

Factor	Factor Name	Factor-Forming Item Numbers	Factor Description
1	Affective Engagement in Mathematics	3, 9, 12, 4, 20, 23, 17	Affective engagement, beliefs, and students' interest in learning mathematics
2	Flexible Mathematical Problem-Solving	2, 14, 16, 13, 15, 24, 21	Flexibility and perseverance in solving mathematical problems
3	Mathematics Avoidance and Helplessness	22, 8, 7, 6	Tendency to avoid mathematics, give up, and dependence
4	Self-Regulated Mathematics Learning	11, 5, 1, 10, 19, 18	Planning monitoring, and self-control in the mathematics learning process

Factors 5 and 6 were eliminated because they did not meet construct stability criteria; factor 6 consisted of only one item and factor 5 contained only three items that were conceptually close to self-regulation. These conditions can affect construct reliability [42]. In this case, model refinement was conducted and the factor structure was consolidated into four main factors that are more stable theoretically and empirically.

Results of reliability estimation

Construct reliability in this study uses the Omega coefficient (ω). The results will be more accurate compared to Cronbach's alpha in estimating internal consistency in multidimensional-oriented instruments [25,36,42]. A construct is considered reliable if the Omega coefficient value is greater than 0.7 [20,41]. Based on the calculation results, all factors in the mathematical disposition instrument demonstrate a high level of reliability. Details of the Omega coefficients from the analysis using the R program software are presented in Table 7.

Table 7. Estimation of omega reliability coefficients

Latent Factor	Number of Items	Omega (ω)	Criteria
Affective Engagement in Mathematics	7	0.806	Reliable
Flexible Mathematical Problem-Solving	7	0.801	Reliable
Mathematics Avoidance and Helplessness	4	0.776	Reliable
Self-Regulated Mathematics Learning	6	0.830	Reliable

Reliability testing also needs to examine the Composite Reliability (CR) coefficient value to strengthen the internal consistency of the instrument. The selection of CR is because it is capable of providing a more accurate estimation compared to Cronbach's Alpha, especially in models with indicators that have different factor loadings [43]. A construct is considered reliable if the CR value is greater than 0.7 [37,44]. The analysis results can be seen in Table 8.

Table 8. Estimation of composite reliability (CR) coefficients

Construct	Number of Items	$\sum(\lambda^2)$	$\sum(e)$	CR	Criteria
Mathematics Disposition	24	9.866	14.134	0.942	Reliable

Based on the calculation results, the mathematical disposition instrument obtained a CR value of 0.942, thus meeting the very reliable criteria. This condition indicates that all statement items are consistently capable of measuring the mathematical disposition construct in a stable manner.

Discussion

Validity and reliability of the instrument

The results of this study indicate that the developed mathematical disposition instrument has comprehensively met the requirements for construct validity and reliability. The KMO value of 0.874 indicates that sample adequacy is in the very good category for conducting factor analysis, as explained by [44] that KMO values above 0.8 fall into the meritorious category. In addition, the Bartlett's Test of Sphericity results that are significant at p = 0.000 show that inter-item correlations do not form an identity matrix, so factor analysis is feasible to conduct [21]. This means that statistically, the empirical data have met all requirements for conducting EFA analysis.

Construct reliability results are used to examine the measure of internal consistency of a set of indicators to measure a latent concept (construct) in research. Proof of construct reliability is conducted through two reliability estimation tests. First, using the Omega (ω) coefficient to examine the reliability coefficient of the formed latent factors. Research findings show that the Omega (ω) coefficient of each latent factor is > 0.7. This means that the items in each latent factor are stable and provide similar results if used again.

Second, using the CR coefficient to strengthen the internal consistency of the instrument. The CR estimation results show a reliability coefficient of more than 0.7, so these results indicate that the mathematical disposition instrument can provide stable estimation results. The findings regarding these reliability estimation results are supported by [6,45,46], who state that if the reliability estimation is above 0.60 or 0.70, then the statement items of the instrument are considered adequate or of good quality for use in research. A reliable instrument enables researchers to collect data with a higher level of confidence. Based on the validity and reliability results, it shows that this instrument is not only valid in terms of construct, but also very consistent in measuring mathematical disposition.

Four-factor structure of mathematical disposition

extraction process in EFA yielded four main factors that explain a total variance of 46.460% after rotation. This percentage is considered adequate for psychological and affective instruments in the field of education, as explained by [23] that approximately 40-60% already reflects a stable construct structure. These four factors are Affective Engagement in Mathematics, Flexible Mathematical Problem-Solving, Mathematics Avoidance and Helplessness, and Self-Regulated Mathematics Learning. This factor structure is consistent with the theory of mathematical disposition proposed by [17–19], who state that mathematical disposition is a multidimensional construct that encompasses affective, cognitive, and metacognitive aspects.

The first factor, Affective Engagement in Mathematics, describes students' emotional involvement, confidence, and perseverance when interacting with mathematics. This factor has the highest eigenvalue, making it the most dominant factor. This factor is highly aligned with the affective domain that is the main focus in many disposition studies [3,47]. In addition, this finding is aligned with research by [6,30], which emphasize that affective engagement plays a significant role in enhancing students' participation and success in mathematics learning. The findings in this research encompass aspects of beliefs and interest, which are core indicators in NCTM standards and Beyers' research, namely interest, curiosity, and attitudes [3,45,47]. This aspect in other research is often referred to as attitude (emotional reactions to mathematical activities) and emotions associated with the subject [13,46]. Other sources refer to it as the dimension of students like learning mathematics [30].

The second factor, Flexible Mathematics Problem-Solving, demonstrates students' tendency to think flexibly and try various strategies in solving problems. These results are aligned with the theory of [19] regarding adaptive reasoning, as well as research by [48], which states that cognitive flexibility is an important component in mathematical creativity. This factor combines cognitive and behavioral aspects that are crucial in mathematical proficiency. The findings about flexibility and perseverance reflect what in the literature is referred to as strategic competence, which is the ability to formulate, represent, and solve problems flexibly [19]. Other literature mentions that flexibility is the openness to try various alternative methods in solving problems [15,47]. Perseverance is also a key indicator that shows serious effort to find ways to solve problems despite facing challenges [12,15,47].

The third factor, Mathematics Avoidance and Helplessness, reflects students' tendency to avoid mathematics due to a sense of inability or anxiety toward the subject matter. In this case, it supports the findings of [10,16], who state that negative perceptions of mathematics can decrease disposition and have an impact on low learning outcomes. This factor represents the negative side or barriers in mathematical disposition that frequently emerge in recent research. This finding is related to the tendency to avoid mathematics and give up, which is highly relevant to the math anxiety dimension found in other instrument validations [13,46]. The behaviors of giving up and dependence are often associated with the view that mathematical ability is a fixed ability, which makes students tend to avoid challenging problems and easily become discouraged by failure [19].

The fourth factor, Self-Regulated Mathematics Learning, describes students' ability to regulate their learning process independently, including perseverance, learning awareness, and the ability to monitor their own understanding. This factor reinforces the findings of [8,15]' who reveal that self-regulation is crucial in determining the quality of learning and mathematical problem-solving ability. This finding is related to planning and monitoring in the learning process; the findings in this study are identical to the monitoring and reflecting indicators in the literature [15,47]. Previous research emphasizes the importance of students taking responsibility for reflecting on their tasks and making necessary adjustments when solving problems [49]. This is aligned with the self-concept aspect where students view themselves as capable of controlling their own learning process [19,46].

Based on these results, the four-factor structure in this study describes a more concise yet comprehensive picture compared to the seven-factor model [19,49] or the seven-dimension model in the research of Soesanto & Dirgantoro (2023). This finding successfully groups scattered indicators into more functional categories, namely emotional engagement, strategic ability, psychological barriers, and metacognitive control. This finding successfully modernizes the classical NCTM and Kilpatrick indicators by grouping them into more tangible psychological functions in the classroom, especially by incorporating the avoidance aspect that often becomes a major barrier in students' disposition today [12,45].

The findings of this study have theoretical and practical implications. Theoretically, this instrument strengthens the multidimensional model of mathematical disposition related to attitudes, interests, confidence, and self-regulation in learning mathematics. Practically, this instrument can be used by teachers to identify students with low disposition, design effective learning interventions, or monitor the development of disposition in the learning process. This instrument can also be used as a basis for further IRT-based analysis, as recommended by [20,39,41]. In addition, this mathematical disposition instrument also has connections with the concept of deep learning. Students with strong affective engagement and high self-regulation ability tend to build deeper conceptual understanding, use flexible strategies, and demonstrate persistence in solving complex problems. Therefore, this instrument can be used as a diagnostic tool to predict students' readiness in achieving deep learning in mathematics learning.

Conclusion

Based on the analysis results, it can be concluded that the developed instrument has met the criteria for excellent psychometric feasibility. The KMO value of 0.874 indicates that the data have very adequate sample adequacy, while the significant Bartlett's Test of Sphericity (p = 0.000) confirms that inter-item correlations are suitable for analysis through EFA. The extraction process yielded four main factors, namely Affective Engagement in Mathematics, Flexible Mathematical Problem-Solving, Mathematics Avoidance and Helplessness, and Self-Regulated Mathematics Learning, with a total explained variance of 46.460%. In addition, this mathematical disposition instrument also proved to be reliable. The omega reliability values for each factor are in the range of 0.776 to 0.830, while the CR value of 0.942 indicates that the instrument has very high internal consistency. This means that the developed mathematical disposition instrument is declared valid and reliable, and is suitable for use in measuring high school students' mathematical disposition accurately, comprehensively, and can support the implementation of affective assessment in mathematics learning.

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