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СЕМАНТИЧЕСКАЯ АЛГЕБРА: МЕЖКУЛЬТУРНЫЙ ПОДХОД К ОЦЕНКЕ КАЧЕСТВА ШКОЛЬНОГО ОБРАЗОВАНИЯ С ТОЧКИ ЗРЕНИЯ РЕШЕНИЯ ПРОБЛЕМ

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Аннотация. Целью данного исследования является разработка эффективного тестового инструмента, отвечающего критериям удобочитаемости, валидности и надёжности, для оценки способности старшеклассников решать проблемы. Исследователи разрабатывали инструмент тестирования в несколько этапов, включая определение целей и задач исследования, составление и написание схем тестирования, проведение тестов на валидность контента, а также оценку надежности конструкции. Результаты исследования показывают, что тестовый инструмент был разработан на основе семантических показателей, включающих четыре категории: ключевые характеристики учебного материала по алгебре, имеющие в своей структуре пять показателей; способы решения проблем, определяемые пятью критериями; и межкультурные маркеры, состоящие из четырех параметров. На основе этого исследования были разработаны пять тестовых заданий по семантической алгебре с учетом межкультурной перспективы, каждое из которых включало три подвопроса, в результате чего в общей сложности было задано 15 вопросов. По результатам проверки достоверности содержания было установлено, что все задания соответствуют критериям достоверности. Проведённый тест на читаемость показал, что тестируемый инструмент может быть хорошо прочитан и понят учащимися. Кроме того, проверка валидности конструкции с использованием корреляции продукта и момента Пирсона показала, что все тестовые задания имели хороший уровень валидности, а коэффициент надёжности также был адекватным, о чём свидетельствует альфа-коэффициент Кронбаха, равный 0,941, который демонстрирует стабильность работы тестируемого прибора при повторных измерениях.

Ключевые слова: разработка тестовых инструментов, проверка достоверности контента, проверка читаемости, проверка достоверности конструкции, проверка надёжности

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Introduction

As a branch of mathematics, algebra plays a crucial role in problem-solving and reasoning. Algebraic thinking, which involves the representation, generalization, and formalization of patterns and order, is considered a core component of mathematics education at the elementary and middle school level (Agoestanto & Rinachyuan, 2020; Basir et al., 2021). Consequently, developing effective methods to assess students' algebraic reasoning abilities has become an important area of research. Student's understanding of the meaning and interpretation of algebraic symbols, expression, structural formal, and representation is a key aspect of algebraic competence, often referred to as "semantic algebra" (Basir et al., 2021).

Algebra presents a significant challenge for most students because of its abstract nature and symbolic representation (Foster, 2007; Stacey & MacGregor, 1999). One of the primary obstacles students face in mastering algebra is a lack of semantic understanding (Erdem et al., 2022; Ferretti, 2019). Semantic understanding is essential for interpreting and manipulating algebraic expressions and equations. This semantic gap often leads to persistent errors, misunderstandings, and difficulties in problem-solving, which hinders students' progress in mathematics (Obot, 2023).

Unlike other areas of mathematics, such as arithmetic, that are more tied to phonological and visuospatial processing, algebra requires a deeper level of semantic processing. Students must be able to interpret the meaning behind symbols and understand the relationship between variables and constants; however, many students have difficulty with this (Cheng et al., 2022). Most students struggle to interpret the variables represented in real-world contexts, which can lead to errors in problem formulation and problem-solving strategies (Prayitno et al., 2022).

One of the most challenging aspects of algebra for students is interpreting word problems into mathematical expressions. This process requires not only good from text (Adams & Lowery, 2007; Ilany & Margolin, 2010). This ability relies heavily on semantic understanding. Research on word problems is a strong predictor of overall math problem-solving performance (Vukovic & Lesaux, 2013; Wong & Yip, 2023). However, many students lack this critical skill, which results in students having difficulty solving complex algebra problems.

Based on the problems and challenges explained above, it is very necessary to develop an effective measurement tool to assess students' semantic understanding in algebra. Current assessments methods often overlook the nuanced aspects of semantic understanding and tend to focus more on procedural knowledge. Based on this, there is a gap in the assessment that causes incomplete information about students' algebra competencies and hinders the development of targeted interventions. It is essential to design a test instrument aimed explicitly at measuring competence in semantic algebra, enabling the better identification of areas that post obstacles to students and the development of more effective theories, methods, and learning strategies to bridge semantic gaps in algebra learning (Witzel & Myers, 2023). This problem can be solved by developing good test instruments that meet the criteria of readability, reliability, and validity to measure students' competence in semantic algebra.

Literature review

1. Linguistic Competence in Algebra

In Learning mathematics, there are important prerequisites that students must master to master advanced material (Ralston et al., 2018). Research has found that many students still experience difficulties in learning algebra, particularly during the transition from arithmetic to algebra an in understanding algebraic symbols (Cañadas et al., 2018; Pitta-Pantazi et al., 2020). The disparity between arithmetic and algebra is the source of this problem because students still struggle to integrate arithmetic competency into algebra, which is full of symbols (Cañadas et al., 2018). Linguistic competency into algebra, particularly in the language of mathematics, is also a problem for students, as they struggle to interpret and manipulate abstract symbols in algebraic contexts. A strong conceptual understanding of algebra will develop if students can effectively link linguistic and algebraic factors (Pitta-Pantazi et al., 2020). There are four views on algebra: general arithmetic, functional thinking, language modelling, and proof in algebra. Each of these views has different cognitive requirements and linguistic skills (Pitta-Pantazi et al., 2020). Based on Stephens's re-

search on teachers' views of algebra, it was found that teachers tend to view algebra as a subject focused on symbol manipulation rather than on generalizations and connections (Stephens, 2008).

Furthermore, this way of thinking among teachers is explained as hindering their teaching and the development of their students' algebraic competencies (Stephens, 2008). Several studies also agree that language is important for learning and explaining mathematical ideas, especially in algebra(Erath et al., 2018; Imm & Stylianou, 2012; Stephens, 2008). In addition to a good understanding of algebraic concepts, teachers need to convey algebraic concepts effectively, using accurate language, so that the disparity between students' informal reasoning and formal algebraic concepts can be overcome. In this situation, linguistics plays a crucial role in developing students' understanding of algebra, which, in turn, impacts their mathematical knowledge.

2. Element of Semantic Understanding

Semantics is a field of linguistics that studies the meaning of words, phrases, and sentences (Iurato, 2017). There are five important elements in semantics, including:

- The connection between words and the real world

Semantics discusses words or symbols and the real world (Vocroix, 2021). Words or symbols can represent one or more concepts used in the real world.

- Context of use

The meaning of a word or phrase can change depending on its context. Semantic understanding involves analyzing the context to determine the precise meaning (Vocroix, 2021).

- Sentence structure

In written language, the structure of sentences plays a crucial role in conveying meaning, as syntactic arrangements of words significantly influence interpretation (Iurato, 2017).

- Synonyms, antonyms, and meaning relationships

Semantic understanding also involves analyzing the relationships between words, including synonyms, which are words with similar meanings, antonyms, which are words with opposite meanings, and hyponyms, which are words whose meanings are included in the meaning of other words (Murphy, 2003).

- Ambiguity and resolving meaning

Semantics help identify and resolve ambiguity in language. Ambiguity occurs when a word or phrase has more than one meaning (Ellis, 2008).

3. The View of an Intercultural Perspective

An intercultural perspective relates to understanding and communicating with individuals and groups from different cultures. A strong intercultural perspective requires strong intercultural competence. Intercultural perspective encompasses several aspects, including intercultural attitudes, knowledge, skills, and behaviors, enabling individuals to interact effectively with people from different cultures (Deardorff, 2019). Intercultural competence is crucial for developing a strong intercultural perspective, as intercultural attitudes, knowledge, and skills are crucial for effective collaboration across cultures (Deardorff, 2019).

Intercultural and semantic perspectives address the understanding of meaning across diverse cultures. Semantics examines the meaning of words, symbols, phrases, and texts, which are influenced by one or more cultures (Iurato, 2017). The meaning of words, symbols, phrases, and texts will vary depending on person's cultural background (Vocroix, 2021). The intercultural perspective makes language a vital element to prevent misunderstandings in intercultural communication (Ellis, 2008).

4. Problem Solving in Mathematics Education

Problem-solving skills are essential in mathematics education. Problem-solving skills in mathematics relate to students' ability to apply mathematical concepts to find appropriate strategies for solving problems. Problem-solving skills consist of five essential stages: identifying the problem, defining and formulating the problem, exploring problem-solving strategies, implementing the problem-solving techniques, and reviewing the results obtained and evaluating the impact of the adopted problem-solving strategies (Hutapea et al., 2020).

Research Method

This research is development research. Developing the research instruments involved several stages. These stages include determining the research objectives and targets, compiling and writing test design, conducting readability testing, validity testing, and reliability testing, which are carried out to develop a reliable and effective semantic algebra test instruments.

First, define the goal and research objectives (Nortvedt & Buchholtz, 2018). This study aims to design an instrument to measure competence in semantic algebra. Furthermore, semantic algebra competence is constructed based on relevant definitions from the literature previously reviewed.

Second, compiling and writing test blueprints. The blueprints outlined the key aspects of semantic algebra to be measured, such as conceptual understanding, procedural fluency, and problem-solving skills (Nortvedt & Buchholtz, 2018). The blueprint outlines the main aspects of semantic algebra that will be measured, including conceptual understanding, procedural fluency, and problem-solving skills from an intercultural perspective. The test outline is constructed based on the semantic and algebraic indicators being tested. Furthermore, the test items are prepared accordance with the test outline, indicator determination, item formulation, and assessment guidelines (Basir et al., 2021).

Third, content validity. At this stage, experts will validate the instruments. A panel of experts reviewed the initial draft of the test instrument to evaluate the content validity and alignment with the intended competencies (Almutairi & Alsuwayl, 2023; Delima & Cahyawati, 2021). Experts provided input on the clarity, relevance, and appropriateness of the test items to inform revisions to the instrument. The measurements of content validity criteria use a questionnaire with a 4-point Likert scale, namely 1 = not appropriate, 2 = less appropriate, 3 = appropriate, and 4 = very appropriate.

Fourth, the readability instrument. This study examined the readability of the test instrument to ensure it was appropriate for the target population (Malone et al., 2012; McLeod et al., 2021). The readability criteria were measured using a Likert-scale questionnaire. After reading the questions, students were asked to rate the following statement: “I understand the text of the questions I read”. Students then voted on the statement using a 4-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree.

Fifth, Construct Validation and reliability instrument. Validity testing is carried out using Pearson product-moment and validation criteria are determined if Pearson correlation value > Person correlation product-moment value at a significance $\alpha = 0.05$ with degrees of freedom $df = n - 2$. Another way to see the results of the test items in the valid category is with the decision criteria (based on Sig. 2-tailed), namely:

- If Sig. (2-tailed) < α (0.05), then the correlation result is significant, and it is concluded that the question item is valid.
- If Sig. (2-tailed) ≥ α (0.05), then the correlation result is insignificant, and it is concluded that the question item is invalid.

Reliability was examined through a pilot study, using Cronbach’s alpha to assess the instrument’s internal consistency (Almutairi & Alsuwayl, 2023). The instrument was deemed reliable if α ≥ 70, which indicates adequate internal consistency. The resulting test instrument was designed to comprehensively assess students’ competence in semantic algebra, with strong validation and reliability evidenced through the development process (Almutairi & Alsuwayl, 2023; Nortvedt & Buchholtz, 2018; Susanto et al., 2024).

The following presents a development flowchart based on the test instrument development methodology.

This research was conducted at SMA Negeri 1 Berastagi, Karo Regency, North Sumatra Province, Indonesia. The study population consisted of 12th-grade students. The sampling technique employed was purposive sampling, based on the criteria of 12th-grade students who had studied algebra material at the high school level, with a total of 32 students. The purpose of this study was to develop an effective semantic algebra test instrument to measure the problem-solving competencies of high school students in an intercultural perspective. The test instrument was said to be effective and met the criteria of readability, validity, and reliability.

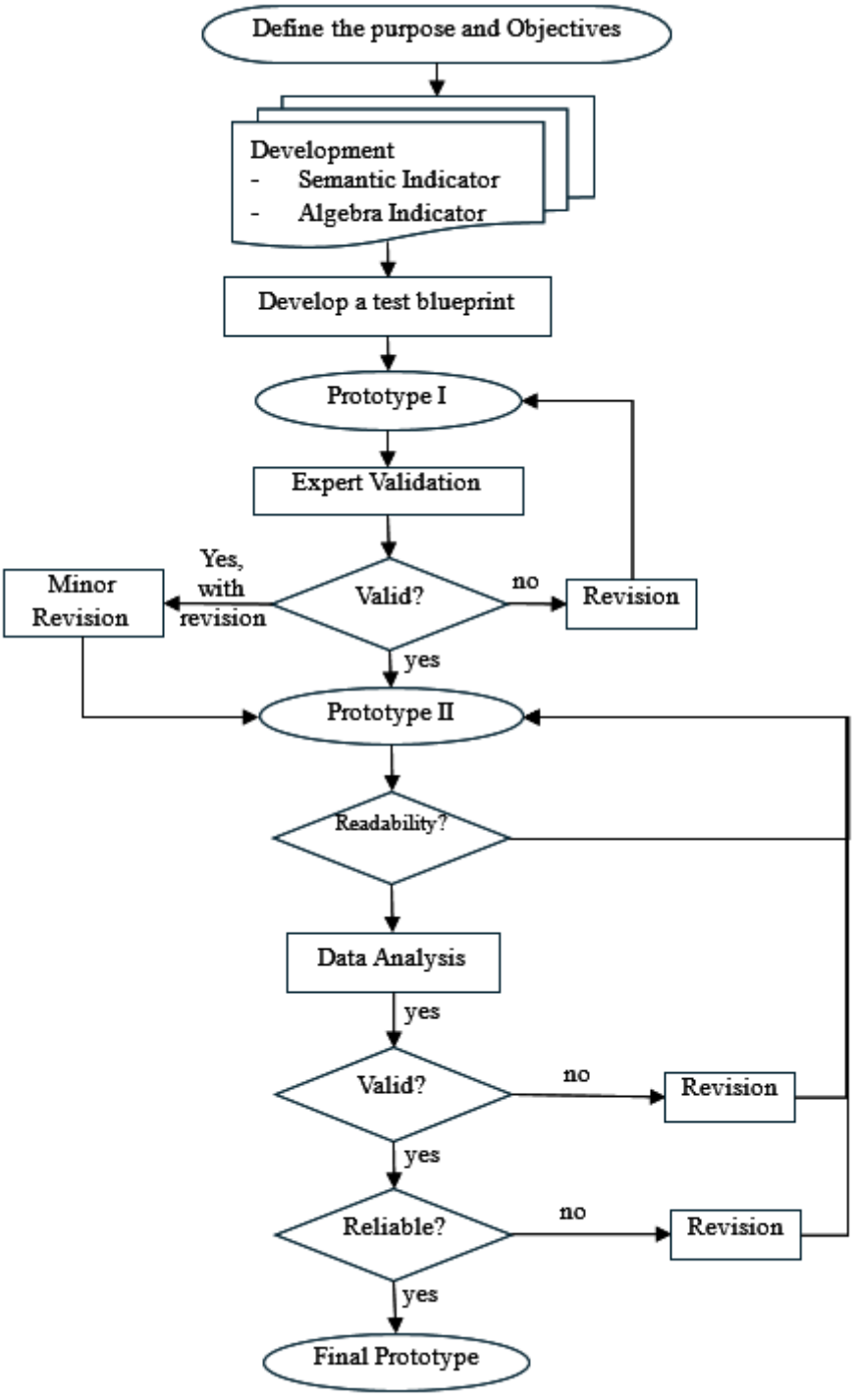

Fig. 1. Flowchart of Development instrument test

Discussion and Results

1. Define the goal and research objectives

As previously explained, the purpose of this research is to develop a semantic algebra test instrument to measure high school students' problem-solving competencies from an intercultural perspective. Based on this, semantic and algebra indicators were developed from an intercultural perspective.

Based on the literature review explained previously, there are five indicators in semantic understanding: the relationship between words and the real world, context of use, sentence structure,

synonyms, antonyms, and meaning relationships. Meanwhile, for algebra material at the high school level, there are four components related to algebra concepts, as presented in Table 1.

Table 1.
Indicator of Algebra material

Component	Explain
Explain the meaning of symbol	This indicator measures the competence of students in connecting the symbols of algebra such as variables, constants, operations, with objects or concepts they represent.
Understanding the relation and mathematics structure	This indicator measures the competence of students in examining each variable and understanding how a change in one variable influences others.
Translating between representations	This indicator measures students' competencies in connecting equations, graph, table, and verbal descriptions.
To connect with the real life	This indicator measures the competencies of students in applying the algebra model that represent real-life situation.

Furthermore, the item indicator of semantic algebra problem from an intercultural perspective was developed through a systematic analysis and elaboration of semantic, algebraic, and intercultural indicators to develop test items. Figure 2 illustrates the mapping of the relationship between semantic indicators, algebraic material indicators, and intercultural competence indicators in the development of the test instruments.

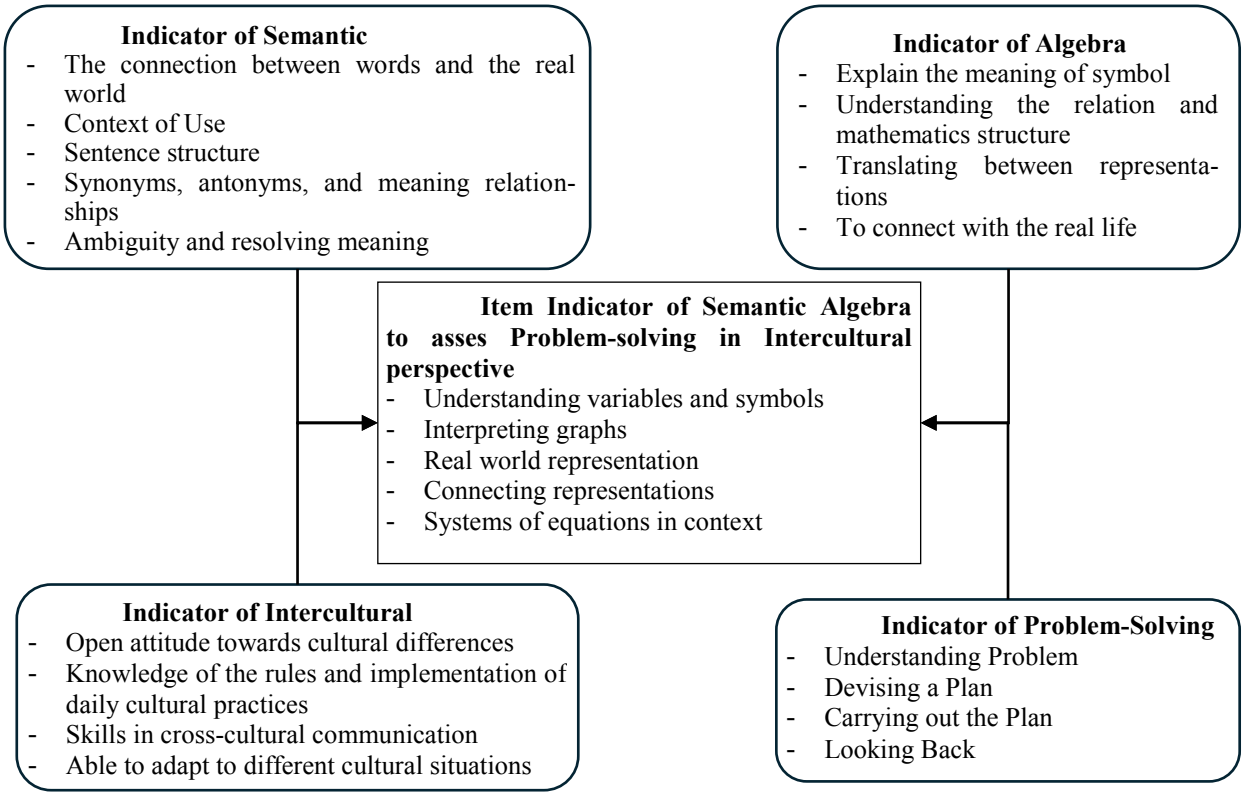

Fig. 2. Item indicator of Semantic Algebra to assess Problem-Solving in Intercultural Perspective

Figure 2 explains that to construct the item instrument indicators, we conducted a systematic analysis and elaboration of indicators from four domains: semantic, algebraic, problem-solving, and intercultural, followed by their synthesis into operational item indicators. Furthermore, five indicators were generated to construct the test instrument. Each indicator was mapped to one item, resulting in a total of five items. Each item contained three questions, resulting in a total of 15 questions.

2. Compiling and writing test blueprints

Based on the results of the indicator development carried out, the following questions were compiled, as presented in Table 2.

Table 2.

The Test Blueprints of semantic algebra to assess problem-solving in intercultural perspective

No	Indicator		Problem	Score
1.	**Algebra** Understanding variables and symbols	**Semantic** - The connection between words and the real world - Context of use - Sentence structure - Synonyms, antonyms, and meaning relationships - Ambiguity and resolving meaning **Problem-Solving** - Identifying problem - Defining and formulating problem - exploring strategies - implementing strategies - reviewing and evaluating strategies **Intercultural** - Cultural openness - Cultural knowledge - Cultural communication - Intercultural adaptability	A store sells concert tickets. Visitors can buy tickets online. The International visitors pay for a VIP ticket in US dollars: \$93.75. Domestic visitors pay for a regular ticket in rupiah: Rp800.000,00. The organizer converts all money into rupiah. Assume \$1= Rp16.000,00. The total number of tickets is 60. If x is the number of VIP tickets bought by international visitors, the total revenue $P(x)$ in rupiah can be written as: $P(x) = (90\times16.000)x + 800.000(60 - x)$. a. What does x represent in this question?	5
			b. Why does the equation include $60 - x$? Explain.	5
			c. If $x = 20$, what is the store's total revenue? What does this result mean?	5
2.	**Algebra** Interpreting Graphs	**Semantic** - The connection between words and the real world - Context of use - Sentence structure - Synonyms, antonyms, and meaning relationships - Ambiguity and resolving meaning **Problem-Solving** - Identifying problem - Defining and formulating problem - exploring strategies - implementing strategies - reviewing and evaluating strategies **Intercultural** - Cultural openness - Cultural knowledge - Cultural communication - Intercultural adaptability	A student from Indonesia joins an online mathematics class with students from several countries. They are studying linear functions in their math class. For the next, they are comparing how temperature changes in two cities from different countries. City A in Indonesia and city B in Russia. The teacher introduces the linear function $y = 3x - 7$, which represents the difference in temperature in ^{0}C between the two cities for one day. x is the number of hours after 08.00 am and y is the "temperature in city A-temperature in city B" The teacher asks the student to analyze the graph of the function. However, the student is unsure how to proceed and needs your help. Please assist the student in answering the following questions: a. What does –7 represent in the graph?	5
			b. If $x = 0$, what is the relationship between y and the graph?	5
			c. If $y = 5$, find the value of x and explain what happens in the graph.	5
3.	**Algebra** Real world representation	**Semantic** - The connection between words and the real world - Context of use - Sentence structure	Students from Indonesia, Brazil, and Japan join an online environmental project. Each team observes an ant colony in their schoolyard and shares the data in a joint mathematics and biology class. One	5

No	Indicator		Problem	Score
		- Synonyms, antonyms, and meaning relationships - Ambiguity and resolving meaning **Problem-Solving** - Identifying problem - Defining and formulating problem - exploring strategies - implementing strategies - reviewing and evaluating strategies **Intercultural** - Cultural openness - Cultural knowledge - Cultural communication - Intercultural adaptability	team in Indonesia finds that the population of an ant colony doubles every week and can be modelled by the equation $P(t) = 50 \cdot 2^t$, where $P(t)$ is the number of ants after t weeks. a. What does the number 50 represent in this equation?	
			b. What happens to $P(t)$ as t increases? Explain verbally	5
			c. How many ants are in the colony after 4 weeks?	5
4.	**Algebra** Connecting representations	**Semantic** - The connection between words and the real world - Context of use - Sentence structure - Synonyms, antonyms, and meaning relationships - Ambiguity and resolving meaning **Problem-Solving** - Identifying problem - Defining and formulating problem - exploring strategies - implementing strategies - reviewing and evaluating strategies **Intercultural** - Cultural openness - Cultural knowledge - Cultural communication - Intercultural adaptability	A student from Indonesia joins an online language-exchange program with students from Japan, Russia, and China. Every week, they track how many new foreign words the Indonesian student learns. The teacher gives a function written as $f(x) = -2x + 10$. Where x is the number of weeks since the language-exchange program started, and y is the total number of new foreign words the student has learned. However, the student is struggling and needs your help. Please assist the student in completing the following: a. Create a table of values for $x = \{-2, -1, 0, 1, 2\}$	5
			b. Plot the graph of the function.	5
			c. What does the number 10 represent in the graph, and how does changing x affect $f(x)$?	5
5.	**Algebra** Systems of equations in context	**Semantic** - The connection between words and the real world - Context of use - Sentence structure - Synonyms, antonyms, and meaning relationships - Ambiguity and resolving meaning **Problem-Solving** - Identifying problem - Defining and formulating problem - exploring strategies - implementing strategies - reviewing and evaluating	A group of students from different cultural backgrounds organize a food stall for their school's National Day. They decided to sell two simple items that everyone can enjoy traditional cakes and fruit juice that use the popular fruits in various cultures. Each cake cost Rp4.000,00, and each juice Rp3.000,00. By the end of the event, the students sold a total of 50 items and earned Rp170.000,00: a. What do the variables x and y represent in the following system of equations? $x + y = 50$ and $4.000x + 3.000y = 170.000$	5

No	Indicator		Problem	Score
		strategies **Intercultural** - Cultural openness - Cultural knowledge - Cultural communication - Intercultural adaptability	b. Explain what the first equation model is in the context of the food stalls.	5
			c. Solve for x and y, then explain the result in the context of the problem.	5

Based on the table of questions provided, it can be explained that each of the algebraic indicators is related to all semantic indicators and intercultural indicators, meaning that each question fulfils the semantic indicators in an intercultural perspective.

3. Content Validity

Table 3 presents the results of the validity assessment for the 15 items, conducted by two experts. The assessment was conducted by completing an assessment instrument prepared in advance by the researchers.

Table 3.
Content validity results by experts

Number of Question	Expert 1	Expert 2	Average	Description
*Q*1*a*	3	4	3.5	Valid
*Q*1*b*	4	4	4	Valid
Q1*c*	3	4	3.5	Valid
*Q*2*a*	4	4	4	Valid
*Q*2*b*	4	4	4	Valid
*Q*2*c*	4	4	4	Valid
*Q*3*a*	4	3	3.5	Valid
*Q*3*b*	3	4	3.5	Valid
Q3*c*	4	4	4	Valid
*Q*4*a*	4	4	4	Valid
*Q*4*b*	4	4	4	Valid
*Q*4*c*	4	3	3.5	Valid
*Q*5*a*	4	4	4	Valid
*Q*5*b*	4	4	4	Valid
*Q*5*c*	3	4	3.5	Valid

Based on the validation results by experts, it was found that each question item fell within the interval $3 \leq \textbf{\textit{Validity}} \leq 4$, indicating that experts considered the question items to be in the appropriate categories. Therefore, it can be said that all the questions were valid. The input from the first expert was that in questions 1a, 1b, dan 1c, it was necessary to add the context of currencies from other countries, which would later need to be converted to Indonesian currency, so that an intercultural perspective would appear in the question items. The second expert provided input to improve the context in questions 3a, 3b, 3c, so that the story context in the questions effectively cross-cultural communication skills.

4. Readability instrument test

Before testing the validity and reliability of this test instrument, it was first piloted on four students to determine its readability. Based on the pilot test results, all tests met the readability criteria.

The following is Table 4, which is the result of the readability test component trial.

Tabel 4.
Readability test

Number of Question	Student-1	Student-2	Student-3	Student-4	Average
*Q*1*a*	3	3	3	3	3
*Q*1*b*	3	3	3	3	3
Q1*c*	3	3	3	3	3
*Q*2*a*	4	4	4	4	4
*Q*2*b*	4	4	4	4	4
*Q*2*c*	4	4	4	4	4
*Q*3*a*	3	4	4	3	3.5
*Q*3*b*	3	3	3	3	3
Q3*c*	3	3	3	3	3
*Q*4*a*	4	4	4	4	4
*Q*4*b*	4	4	4	4	4
*Q*4*c*	4	3	4	3	3.5
*Q*5*a*	4	4	3	3	3.5
*Q*5*b*	3	3	3	3	3
*Q*5*c*	3	3	3	3	3

Based on Table 4, it was found that each question item fell within the interval $3 \leq$ ***readability*** ≤ 4, meaning that four students stated that all the questions item texts had a good level of readability, allowing them to be understood well by the students.

5. Construct validation and reliability instruments

The validity test was conducted to determine the level of correlation between each item's score and the total score using Pearson Product-Moment correlation coefficient. In contrast, the reliability test was conducted to assess the internal consistency of the instrument using Cronbach's Alpha. Based on the calculation results using SPSS 27, the data obtained from the validity test of the test items are presented in Table 5, which consists of 15 questions administered on 32 students.

Table 5.
Test item validity test results

Number of Question	Pearson correlation	Pearson product moment (Level of Significant 0.05 and 2-tailed)	Sig. (2-tailed)	Description
*Q*1*a*	0.658	0.349	< 0.001	Valid
*Q*1*b*	0.758	0.349	< 0.001	Valid
Q1*c*	0.567	0.349	< 0.001	Valid
*Q*2*a*	0.712	0.349	< 0.001	Valid
*Q*2*b*	0.835	0.349	< 0.001	Valid
*Q*2*c*	0.661	0.349	< 0.001	Valid
*Q*3*a*	0.820	0.349	< 0.001	Valid
*Q*3*b*	0.779	0.349	< 0.001	Valid
Q3*c*	0.731	0.349	< 0.001	Valid
*Q*4*a*	0.749	0.349	< 0.001	Valid
*Q*4*b*	0.788	0.349	< 0.001	Valid
*Q*4*c*	0.714	0.349	< 0.001	Valid
*Q*5*a*	0.722	0.349	< 0.001	Valid
*Q*5*b*	0.791	0.349	< 0.001	Valid
*Q*5*c*	0.833	0.349	< 0.001	Valid

Based on Table 5, all questions are valid. Validity values in this case can be seen in two ways. First, compare the Pearson correlation value with the Pearson product-moment value. If each question value is compared, the Pearson correlation value is greater than the Pearson product-moment value. This indicates that each question item is valid. Second, compare the Sig. (2-tailed)

with a probability value of 0.05. Based on Table 3 we have that Sig. (2-tailed) < 0.05. It means that each question item is valid.

Next, Table 6 presents the data from the reliability test results of 15-questions, which was administered to 32 students.

Table 6.
Reliability Statistics

Number of Items	Cronbach's Alpha	Requirement	Description
15	0.941	0.700	Reliable

Based on the data processed using SPSS 27, all questions met the reliability criteria. This is indicated by Cronbach's Alpha value ≥ the value of requirement, which is 0.941 ≥ 0.700.

Conclusion

This research produced an effective semantic algebra test instrument that met the criteria of readability, validity, and reliability to measure students' problem-solving competences from an intercultural perspective. There were five stages in developing the test instrument: defining the goal and research objectives, compiling and writing test blueprints, content validity, readability test, and construct validity and reliability test.

At the stage of determining research objectives and targets, semantic indicators consisting of five indicators, algebraic material indicators composed of four indicators, and five semantic algebraic indicators from an intercultural perspective. Based on the result obtained, the next stage of compiling and writing the test blueprint was carried out, resulting in the creation of five test items, each consisting of three questions, for a total of 15 questions. The next step was to conduct content validity. In this case, two experts validated all test items. The first expert provided input on test items 1a, 1b, and 1c regarding the addition of question context, and the second expert provided feedback to improve questions 3a, 3b, and 3c, focusing on context related to cross-cultural communication skills. Each expert stated that all test items were valid. From the readability test side, it was found that all questions could be read and understood by students. Four students were involved in this readability activity. The final stage involved a test of construct validity and reliability. Thirty-two students participated in the trial. Based on the analysis, all developed test instruments met the validity criteria, demonstrating that the test can measure semantic algebra problem-solving competency from an intercultural perspective. In terms of reliability, the test instrument showed a Cronbach's alpha coefficient of 0.941, indicating the stability of the test results in repeated measurements.

Moving forward, further development of this test instrument is necessary, which is expected to result in the creation of more flexible and applicable measurement tool, tailored to curriculum developments and future evaluation needs. Further research is also needed to explore the potential of this test instrument to strengthen its validity and reliability.

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SEMANTIC ALGEBRA: AN INTERCULTURAL PERSPECTIVE TO PROBLEM-SOLVING ASSESSMENT OF HIGH SCHOOL EDUCATION

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Abstract. This study aims to develop an effective test instrument that meets the criteria of readability, validity, and reliability to measure the problem-solving competency of high school students. Researchers developed the test instrument through several stages, including determining the research objectives and targets, compiling and writing the test blueprints, conducting content validity and readability tests, and assessing construct validity and reliability tests. The results of the study indicate that the test instrument was developed based on semantic indicators, comprising four categories: the key characteristics of the algebra teaching material, which have five indicators in their structure; problem solving methods determined by five criteria; and intercultural markers, consisting of four parameters. Based on this development study, five semantic algebra test items were developed from an intercultural perspective, each comprising three subquestions, resulting in a total of 15 questions. Based on the results of content validity, it was found that all items met the validity criteria. The readability test conducted showed that the test instrument could be read and understood well by students. Furthermore, the construct validity test using the Pearson product-moment correlation showed that all test items had a good level of validity, and the reliability coefficient was also adequate, as indicated by the Cronbach's alpha coefficient of 0.941 which demonstrated the stability of the test instrument across repeated measurements.

Keywords: development of test instruments, content validity test, readability test, construct validity test, reliability test

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