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The Real Connections, Meaningful Algebra: Developing an Algebra Assesment Instrument Based on Construct Centered Design

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Abstract

The low mathematical connection ability of junior high school students, particularly in algebra, remains a fundamental problem unsystematically addressed in Indonesian assessment practice. This study aims to develop a contextual-based algebraic connection instrument using the Construct Centered Design (CCD) approach that is valid, practical, and effective for ninth-grade junior high school students. A Research and Development (R&D) method was employed with a four-phase CCD design: (1) construct definition, (2) evidence design, (3) task design, and (4) evaluation. The instrument was piloted with 34 ninth-grade students at SMP Negeri 1 Kabupaten Sorong in the 2024/2025 academic year. Results indicate: (1) instrument validity reached 88.3% (very valid); (2) teacher practicality 85.0% and student practicality 82.6% (both very practical); (3) classical completeness 79.4% (effective). Student response analysis showed that the CCD based instrument can stratify students' connection profiles across three dimensions: inter-concept connections, cross-disciplinary connections, and contextual connections. The implications affirm the urgency of integrating construct-based approaches in developing mathematics assessment instruments to support Merdeka Curriculum implementation.

Keywords: Assessment Instrument; Contextual; Construct Centered Design; Junior High School Algebra; Mathematical Connection Ability

INTRODUCTION

Mathematical connection ability is one of the five standards of the mathematics learning process set by the National Council of Teachers of Mathematics (NCTM, 2000) and reinforced by a 21st-century mathematical framework (Gravemeijer et al., 2017). This ability encompasses students' ability to identify and utilize connections between mathematical ideas, between mathematics and other disciplines, and between mathematics and real-life contexts. Without adequate connection skills, students view mathematics as a collection of isolated algorithms and meaningless memorization.

The reality on the ground shows conditions that are far from ideal. PISA 2022 data place Indonesia 68th out of 81 participating countries in mathematics literacy, with an average score of 366, far below the OECD average of 472 (OECD, 2023). More specifically, Indonesian students' greatest weaknesses lie in the employing and interpreting categories, both of which demand strong mathematical connection skills in the space and shapes content. This finding is reinforced by (Rawani, 2021) research, which concluded that more than 67% of ninth-grade junior high school students were unable to solve problems that required connections between algebra and real life (Rawani, 2021).

Algebra is the most critical terrain in this connection issue. Grade IX algebra material includes systems of linear equations in two variables (SLEs), quadratic functions, and quadratic equations and inequalities, which have an extraordinarily rich network of connections: internal (with geometry, statistics, and trigonometry), external (with physics, economics, and biology), and real-life (with financial planning, engineering, and design). Ironically, it is precisely this richness of connections that is often overlooked by existing assessment instruments. Most algebra questions in textbooks and national exams are procedural and one-dimensional, not designed to measure mathematical connections (Hasbullah, 2020). The fundamental problem is not simply the quality of the questions, but the absence of a systematic framework in the instrument development process. Most mathematics assessment instruments in Indonesia are developed intuitively, without an explicit cognitive-theoretical foundation for the constructs they are intended to measure (Ismail, 2024). As a result, the resulting instruments often have weak construct validity: items do not consistently measure the same abilities, assessment rubrics are not logically connected to the constructs, and inferential conclusions from student scores are not accountable.

Construct Centered Design (CCD) emerged as a response to these fundamental weaknesses. CCD is an instrument development approach rooted in the Assessment Triangle (Pellegrino, 2001) and further developed by (Wilson, 2005). Unlike conventional development models that focus on questions as a starting point, CCD places the construct, namely the psychological variable to be measured, as the central point that guides the entire process: from defining indicators, designing tasks, to interpreting scores (Wilson, 2005). This coherence ensures that each element of the instrument is logically connected to the target construct, so that the validity of the instrument is guaranteed not procedurally but substantively.

Here are three relevant studies to be included in the preliminary part of the research on the development of CCD-based algebraic connection instruments. These three studies support the importance of developing instruments that are based on theoretical constructs and have evidence of psychometric validity. Develop and evaluate APCR-CC instruments to measure students' conceptual readiness in algebra and precalculus using an Item Response Theory (IRT) based psychometric approach (Peralta, 2019). The results of the study showed that the instrument has a one-dimensional construct, meets the assumption of local independence, and is sensitive to changes in students' abilities after learning. This study confirms that the development of the instrument must begin with the formulation of a clear construct and be followed by strong empirical validation, in line with the principles of CCD. In addition to showing the validity of the construct, Peralta (2019) also showed that around 80% of the questions are sensitive to learning and can accurately distinguish students' conceptual abilities (Peralta, 2019). The findings show that instruments developed based on well-defined constructs produce more valid measurements compared to instruments that are only oriented to material coverage. This strengthens the use of CCD as an approach in developing algebraic connection instruments. Develop mathematical diagnostic instruments through the stages of identification of ability attributes, grid preparation based on constructs, expert validation, empirical tests, and reliability and validity analysis using cognitive diagnostic models (Tang, 2020). The results of the study showed that the instrument had high reliability and classification accuracy in identifying students' abilities. Although it focuses on rational number operations, the instrument development procedure is very relevant to the CCD approach, especially in designing instruments based on the construct of the ability to be measured. In contrast to the research conducted, It is explained that the use of ECD in test development produces instruments that have a strong relationship between measurement objectives, ability indicators, question characteristics, and score interpretation (Zieky, 2014). The study also emphasizes that ECDs are very effective in developing assessments that measure complex abilities, such as mathematical reasoning, problem-solving, and critical thinking

The three studies show that the development of quality mathematical instruments requires a clear construct foundation, a systematic validation process, and adequate psychometric analysis. However, these studies still focus on the conceptual ability of algebra or the diagnosis of mathematical ability in general, so it has not specifically developed an instrument to measure algebraic connections based on the Construct-Centered Design (CCD) framework. Therefore, this study seeks to fill this gap by developing an algebraic connection instrument that is systematically designed based on theoretical constructs so as to be able to produce more valid evidence regarding students' algebraic connection abilities.

Several recent studies have demonstrated the superiority of CCD in developing mathematics assessment instruments. Suciati, 2020) used CCD to develop a mathematics literacy instrument and reported 89.1% validity with 77.5% classical completeness (Suciati, 2020). The same goes for (Hernandez & Pauline, 2017), who demonstrated that construct-based instruments produced more informative data about students' conceptual understanding compared to conventional instruments. At the international level, (Schoenfeld, 2023) asserts that a construct-based approach is the only way to ensure coherence between learning theory, teaching practice, and assessment practice in mathematics (Schoenfeld, 2023). Based on the theoretical and empirical gaps, this study aims to: (1) develop a contextual-based algebraic connection question instrument using a valid CCD approach for ninth-grade junior high school students; (2) describe the practicality of the instrument based on the perspectives of teachers and students; and (3) analyze the effectiveness of the instrument in measuring and differentiating the profile of students' algebraic connection abilities.

RESEARCH METHODS

Research Types and Designs

This study used the Research and Development (R&D) method with a CCD adapted from Wilson (2005) and Haertel (2004). R&D was chosen because this study aims to produce a product, namely an assessment instrument, which is then systematically tested for validity, practicality, and effectiveness. The CCD design was chosen because it is able to ensure coherence between the target construct, the collected evidence, and the designed tasks, thus producing a substantively valid instrument (Wilson, 2005).

In the development of the instrument, this research adopts CCD developed by Mark Wilson. CCD is a systematic approach in the development of instruments centered on the constructs to be measured. All components of the instrument must be designed based on theoretical constructs so that each item of the question truly represents the ability that is the target of the measurement (Wilson, 2005). Thus, the preparation of instruments is not only oriented to making problems, but begins with a clear definition of constructs, determination of evidence that shows mastery of constructs, preparation of tasks that are able to produce such evidence, and preparation of an interpretation system of measurement results.

The CCD approach is also supported by Edward, who states that the quality of the instrument is largely determined by the suitability between the constructs measured, the empirical evidence collected, and the assessment tasks given to the learners. Therefore, the instrument development process must ensure that there is a logical relationship between the construct definition, ability indicators, question characteristics, and score interpretation so that the instrument has a strong construct validity.

According to (Wilson, 2005), calcifying CCD consists of four main components, namely 1) Construct Map, which is to formulate the construct of algebraic connection ability and the level of development of students' abilities based on theoretical studies; 2) Item Design, which is designing a question item that can produce evidence of the achievement of each algebraic connection indicator; 3) Outcome Space, which is to compile a scoring rubric or response category that describes variations in the level of ability of students, and 4) Measurement Model, which is to test the quality of instruments through analysis of validity, reliability, difficulty, differentiation, and measurement modeling so that the assessment results can be interpreted accurately (Wilson, 2005).

In this study, the four components of CCD were implemented in stages. In the initial stage, the identification of algebraic connection constructs was carried out through theoretical studies and literature studies. The construct was then translated into operational indicators that are the basis for the preparation of grids and question items. Furthermore, a scoring rubric was prepared in accordance with the characteristics of the students' answers. The initial product was then validated by material experts, educational evaluation experts, and mathematics education practitioners before being tested on junior high school students. The test results data were used to analyze the validity, reliability, difficulty, differentiating power, and practicality of the instrument, so that an algebraic connection instrument that meets the quality standards of educational measurement was obtained. By using the R&D method combined with the Construct Centered Design approach, the development of instruments in this study not only produces a set of questions, but also produces assessment instruments that have a strong theoretical basis, are constructively valid, are practically used by teachers, and can measure students' algebraic connection abilities comprehensively.

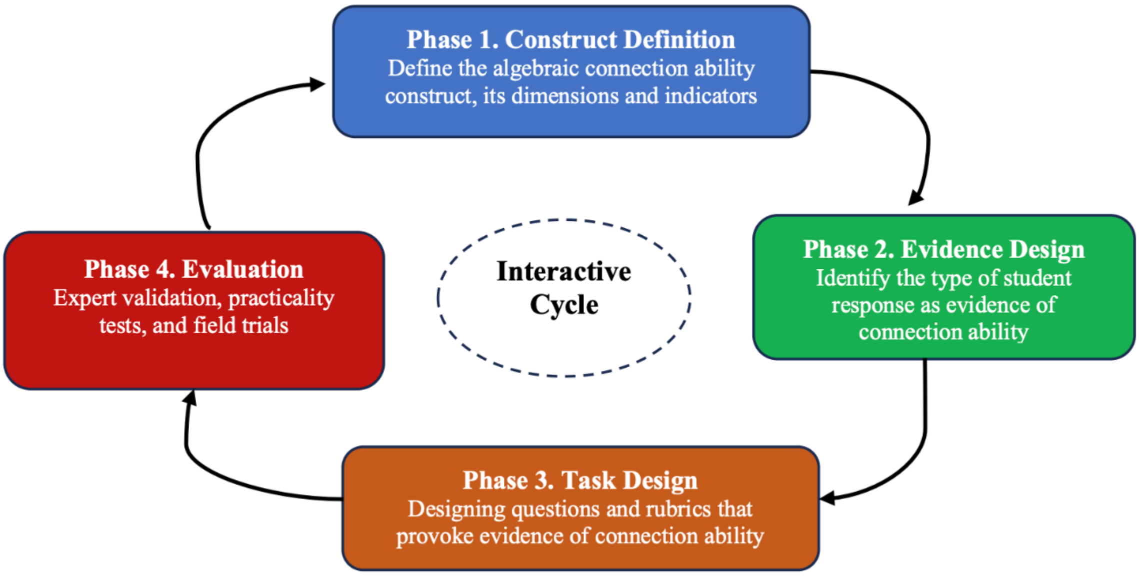

Figure 1. The CCD development model in this study consists of four phases which are implemented interactively.

Research Subjects

The research was conducted at SMP Negeri 1 Sorong Regency in the even semester of the 2025/2026 academic year. The research subjects included: (a) three expert validators, namely a junior high school mathematics material expert from Muhammadiyah Sorong University of Education, an instructional design expert from Muhammadiyah Sorong University of Education, and a psychometric expert from Makassar State University; (b) two grade IX mathematics teachers of SMP Negeri 1 Sorong Regency as practicality assessors; and (c) 34 grade IX-B students of SMP Negeri 1 Sorong Regency as trial subjects. The selection of student subjects used a purposive sampling technique, with the criteria: students who have completed all grade IX algebra materials.

Development Procedure Using 4 Phase CCD

1. Phase 1 - Construct Definition

This phase begins with a systematic review of the literature on mathematical connection skills (NCTM, 2000; Kieran, 2022; Kaur & Lam, 2012) and analysis of grade IX algebra competency standards in the Independent Curriculum (Mendikbudristek, 2022). Based on this study, the construct of "algebraic connection ability" was operationally defined into three main dimensions with 10 measurable indicators. Each indicator was then verified for consistency with the parent construct through a panel discussion with three experts.

2. Phase 2 - Evidence Design

In this phase, the research team identified the types of student responses that could serve as evidence for each construct indicator. Evidence of algebraic connection skills was determined to be: (a) written product in the form of a problem solution that demonstrates the use of interconceptual connections; (b) written explanations of the interconceptual relationships used; and (c) written interpretations of the solution's meaning in the context of a real-world problem. Based on these three types of evidence, a 4-level analytical assessment rubric was developed for each test item.

3. Phase 3 - Task Design

The item design phase was conducted based on the specifications established in Phases 1 and 2. Each item was designed with attention to: (a) contextual relevance to the lives of 14-15-year-old students; (b) the ability to elicit evidence of the targeted connections; (c) language readability; and (d) a realistic timeframe. An initial draft of 12 items was developed, then reduced to the top 10 items after an internal review by the research team.

4. Phase 4 - Evaluation

The evaluation phase consisted of three sub-stages: (1) expert validation involving three validators who assessed the instrument using a structured validation sheet; (2) practicality testing involving two teachers who assessed practicality using a 25-item questionnaire, and 34 students who assessed it using an 18-item questionnaire; and (3) field trials involving 34 students who completed 10 questions in two sessions (each 60 minutes).

Data Collection Instruments

Table 1. Research Data Collection Instruments

Number	Instrument	Objective	Number of Items	Scale
1	Expert Validation Sheet	Measuring content, construct, and linguistic validity	36 items	Likert 1 – 4
2	Teacher Practicality Questionnaire	Assessing the ease and feasibility of implementation	25 items	Likert 1 – 4
3	Student Practicality Questionnaire	Assess the readability and interestingness of the questions	18 items	Likert 1 – 4
4	Question Sheet + Rubric	Measuring students' algebraic connection abilities	10 items	Analytical rubric 0 – 4

Data Analysis Techniques

Data analysis was conducted using the following techniques. First, validity was calculated based on the average percentage of validation scores from the three experts, with the following criteria: ≥85% = very valid, 70–84% = valid, 55–69% = quite valid, <55% = not valid. Second, practicality was calculated based on the average percentage of questionnaire scores with the following criteria: ≥80% = very practical, 65–79% = practical, 50–64% = quite practical, and <50% = not practical. Third, effectiveness was assessed from the percentage of classical completion: students were declared complete if they obtained a score of ≥75% of the maximum score, with the effective criterion if ≥75% of students completed. In addition, an analysis of student connection profiles was conducted based on scores per dimension to describe the pattern of strengths and weaknesses of students' algebraic connections.

RESULTS AND DISCUSSION

Results

1. Construct Definition: Specification of the Algebraic Connection Ability Construct

Based on Phase 1 of CCD, the construct of the algebraic connection ability of ninth-grade junior high school students was operationalized into three main dimensions and ten measurable indicators as presented in Table 2. These ten indicators were validated for their consistency with the parent construct through expert panel discussions and were declared conceptually valid.

Table 2. Specifications of the Class IX Algebraic Connection Ability Construct

Number	Instrumen	Objective	Number of Items	Skala
1 – 4	Connections Between Mathematical Concepts	(1) Connecting SPLDV with graphical representation; (2) Connecting the roots of quadratic equations with Cartesian coordinates; (3) Connecting quadratic functions with optimization concepts; (4) Using algebraic properties to verify connections between topics	S1, S2, S3, S4	1 – 4
5 – 7	Cross-Disciplinary Connections	(5) Applying algebra in the context of physics (parabolic motion); (6) Using algebraic models in economic analysis (profit and loss, break-even point); (7) Applying algebra in the context of biology (population growth)	S5, S6, S7	5 – 7
8 – 10	Contextual Connections (Real Life)	(8) Modeling real business problems into systems of equations; (9) Interpreting mathematical solutions in the context of real decisions; (10) Formulating and validating algebraic models based on real data	S8, S9, S10	8 – 10

2. Task Design: Description of the Instrument Developed

Based on the construct specifications in Table 2, 10 descriptive questions based on real-world contexts were developed. Each question encompasses at least two dimensions of connection to encourage holistic integration of skills. The distribution of questions and the contexts used are presented in Table 3.

Table 3. Distribution of Questions Based on Context, Dimension, and Algebra Topic

Code	Question Context	Connection Dimensions	Connected Algebra Topics
S1	Millennial cafe business (menu and profits)	Interconceptual + Contextual	SPLDV ↔ Linear Function ↔ Optimization
S2	Parabolic city park design	Interconceptual + Contextual	Quadratic Equation ↔ Cartesian Coordinates

S3	Number patterns on bamboo weaving (crafts)	Interconcept	Quadratic Functions ↔ Number Sequences
S4	Residential electrical network	Interconceptual + Cross-disciplinary	SPLDV ↔ Function ↔ Physics (Ohm's Law)
S5	Water rocket trajectory in science competition	Cross-Discipline (Physics)	Quadratic Function ↔ Parabolic Motion
S6	Break-even analysis of local food businesses	Cross-Discipline (Economics)	SPLDV ↔ Linear Function ↔ Break-Even Point
S7	Honey bee colony growth (agriculture)	Cross-Discipline (Biology)	Quadratic Equation ↔ Growth Model
S8	Home renovation planning (budget & materials)	Contextual + Interconceptual	SPLDV ↔ Quadratic Equation ↔ Budget
S9	Music concert ticket pricing strategy	Contextual + Cross-disciplinary	Quadratic Function ↔ Revenue Optimization
S10	Arch bridge modeling based on GPS data	Contextual + Interconceptual	Quadratic Equation ↔ Coordinates ↔ Civil Engineering

The following is an example of a developed problem (Problem S6) as an illustration of the implementation of context-based CCD. This problem is designed to elicit interdisciplinary connections (economics) as well as interconceptual connections (SPLDV and linear functions):

Question S6. Break-Even Analysis of Local Food Businesses

Dimensions: Cross-Disciplinary Connections (Economics) + Inter-Concept Connections

Dinda is a junior high school student who sells fried cassava chips in the school cafeteria to save money for study tours. She spends a fixed daily cost of Rp. 15,000 for storefront rental and Rp. 4,000 for each pack of chips produced (raw material costs). She sells each pack for Rp. 7,500.

a. Express the total production cost C(x) and total revenue R(x) as a function of the number of packs (x) sold. Write this as a mathematical equation!
b. Determine the break-even point for Dinda's business. The solution is presented in three different representations: (i) an algebraic equation; (ii) a table of values, and (iii) a graph sketch. Explain what the break-even point means for Dinda's business decisions!
c. If Dinda's profit target is Rp. 50,000 per day, how many minimum packs should she sell? Connect your answer to the concept of linear inequalities in one variable that you have learned!
d. In your opinion, what mathematical concepts are connected to this problem? Identify at least three connections and explain their relevance to the real life of young entrepreneurs!

3. Expert Validation Results

Instrument validation was conducted by three expert validators using a 36-item validation sheet covering four aspects: content validity, construct validity, linguistic validity, and CCD coherence. The complete validation results are presented in Table 4.

Table 4. Expert Validation Assessment Results

No.	Validation Aspect	V1 (%)	V2 (%)	V3 (%)	Average (%)	Category
1	Content Validity (construct-indicator suitability)	90.3	87.5	88.9	**88.9**	**Very Valid**

2	Construct Validity (quality of question structure)	87.5	90.3	86.1	**88.0**	**Very Valid**
3	Contextuality (relevance of real context)	91.7	88.9	87.5	**89.4**	**Very Valid**
4	Language and Readability	86.1	83.3	87.5	**85.6**	**Very Valid**
5	CCD coherence (construct-proof–task)	90.3	88.9	90.3	**89.8**	**Very Valid**
6	Quality Assessment Rubric	86.1	87.5	88.9	**87.5**	**Very Valid**
	Total Average	**88.4%**	**87.7%**	**88.2%**	**88.3%**	**Very Valid**

Table 4 shows that the developed instrument achieved an average total validity of 88.3%, which is in the highly valid category (≥85%). The CCD coherence aspect scored the highest (89.8%), confirming that the construct-based development process successfully produced an instrument with strong internal alignment. The linguistic aspect scored the lowest (85.6%), which remains in the highly valid category but provides room for improvement.

The first validator (a content expert) noted that three items (S4, S7, and S10) required context simplification to make them more accessible to junior high school students without losing their rich connections. The second validator (an instructional design expert) suggested adding scaffolding in the form of guiding questions to items requiring complex connections. The third validator (a psychometrician) recommended clarifying the rubric criteria at levels 2 and 3 to improve interrater reliability. All of these suggestions were revised before the field trial.

4. Practicality Assessment Results

The practicality assessment was conducted by two ninth-grade mathematics teachers (teacher practicality) and 34 students (student practicality). Table 5 presents the detailed results of the practicality assessment.

Table 5. Results of Teacher and Student Practicality Assessment

No.	Practical Aspects	Teacher (%)	Student (%)	Category
1	Ease of implementation and administration	87.5	83.3	Very Practical
2	Clarity of instructions and readability of questions	85.0	84.3	Very Practical
3	Relevance of context to student experience	90.0	88.2	Very Practical
4	Adequacy and accuracy of time allocation	82.5	79.4	Practical
5	Quality and operationality of assessment rubrics	85.0	—	Very Practical (Teacher)
6	The attractiveness of the appearance and design of the instrument	82.5	83.8	Very Practical
7	Motivation and intellectual challenges of the matter	—	80.4	Very Practical (Students)
	Total Average	**85.4%**	**83.2%**	**Very Practical**

The results of the practicality assessment showed that the developed instrument achieved an average practicality score of 85.4% for teachers and 83.2% for students, both in the very practical category (≥80%). The aspect that received the highest appreciation from both respondents was contextual relevance (teachers: 90.0%; students: 88.2%), confirming the success of the CTL approach in presenting meaningful situations for users. The aspect of time adequacy received the lowest score, especially from students (79.4%), which suggests that questions with complex connection dimensions (especially S4 and S10) need to be re-examined in terms of cognitive load or given more time allocation.

5. Field Trial Results: Profile of Students' Algebraic Connection Abilities

The field trial was conducted on 34 grade IX-B students in two sessions (60 minutes each). The trial results are presented in two perspectives: (a) completion and achievement per dimension (Table 6) and (b) distribution of students' connection ability profiles (Table 7).

Table 6. Achievement of Algebraic Connection Ability per Dimension

Connection Dimensions	Max Score	Average	% Achievement	% Complete	Category
Connections Between Mathematical Concepts	40	31.4	78.5%	82.4%	Good
Cross-Disciplinary Connections	30	21.9	73.0%	70.6%	Enough
Contextual Connections	40	32.1	80.3%	85.3%	Good
Total	**110**	**85.4**	**77.6%**	**79.4%**	**Good**

Table 7. Distribution of Students' Algebraic Connection Ability Profile

No.	Connection Profile	Deskripsi	Description	Persentase
1	High Connection (KT)	Capable in all three dimensions (≥75% in all dimensions)	9 students	26.5%
2	Medium Connection (KS)	Strong in interconceptual & contextual, weak in cross-disciplinary	18 students	52.9%
3	Low Connection (KR)	Not yet capable in ≥2 dimensions (<75%)	7 students	20.6%

Of the 34 students who participated in the trial, 27 students (79.4%) managed to achieve a score of ≥75% of the total maximum score, so that the classical completion reached 79.4% and was included in the effective category (>75%). Analysis per dimension showed an interesting pattern: the contextual connection dimension achieved the highest achievement (80.3%), followed by interconceptual connections (78.5%), while cross-disciplinary connections achieved the lowest achievement (73.0%).

The distribution of ability profiles (Table 7) reveals that the instrument successfully identified three pedagogically meaningful groups of students: the KT Group (26.5%) who had strong connections across all dimensions and were ready for exploratory learning; the KS Group (52.9%) who comprised the majority of students with unbalanced connection profiles; and the KR Group (20.6%) who required targeted remedial intervention. The instrument's ability to produce these stratified connection profiles represents a major added value that conventional instruments cannot achieve, and is concrete evidence of the superiority of the CCD approach.

Discussion

The results of this study consistently confirm three main claims: (1) the instrument developed using the CCD approach has very high validity; (2) the instrument is considered very practical by users; and (3) the instrument is effective in measuring algebraic connection skills in a differentiated manner. These findings have significant theoretical and practical implications.

From a theoretical perspective, the high validity of the instrument (88.3%) strengthens the argument of Wilson, 2005 and Haertel, 2004 that the construct-based approach produces substantively valid instruments, not just procedurally valid (Wilson, 2005; Ibrahim, 2025; (Haertel, 2004). More specifically, the high CCD coherence score (89.8%) indicates that the development process, which began with explicitly defining the construct, successfully produced a coherent chain of inferences: from student scores to ability dimensions to the target construct. This is in line with Mislevy (2007) the postulate on the importance of coherence in assessment systems (Mislevy, 2007)

From an empirical perspective, the finding that cross-disciplinary connections achieved the lowest achievement (73.0%) has important pedagogical consequences. This confirms (Elvyn et al. 2024) finding that algebra learning in Indonesia remains highly intramathematical and under-exposes students to connections between algebra and other sciences. The Independent Curriculum has indeed encouraged an interdisciplinary approach through the Pancasila Student Profile project (Mendikbudristek, 2022). However, its implementation in everyday mathematics learning is still not optimal (Seto et al., 2026).

The instrument's ability to generate stratified connection profiles (Table 7) is one of the most important contributions of this study. Conventional instruments only produce total scores that are uninformative about students' true strengths and weaknesses. CCD-based instruments, with their explicit construct dimensions, produce diagnostic data that can be directly translated into pedagogical decisions: teachers can design targeted interventions for each profile, rather than providing generic, off-target remediation. This finding reinforces Hernandez & Pauline, (2017) the argument for the importance of diagnostically rich assessment instruments.

The limitations of this study should be noted. First, the pilot study was conducted in only one school in Sorong Regency, so generalizing the findings to other school contexts, particularly in remote areas, requires caution. Second, the rubric's interrater reliability has not been formally tested, although a third validator has reviewed the rubric. Further research involving more schools from diverse socioeconomic backgrounds and supplemented with interrater reliability testing is highly recommended.

CONCLUSION

This study successfully developed a context-based algebraic connection problem instrument using the Construct Centered Design (CCD) approach that met the criteria of validity, practicality, and effectiveness for ninth-grade junior high school students. Three main conclusions can be drawn from this study.

1. The developed instrument achieved a validity of 88.3% (very valid), with the CCD coherence aspect as the highest strength (89.8%). This achievement proves that the explicit and systematic construct definition process, a characteristic of the CCD approach, produces a substantively valid instrument: each item can be traced directly to the targeted construct indicators, and the assessment rubric has a clear theoretical basis.
2. The instrument was rated as highly practical by both teachers (85.4%) and students (83.2%). The relevance of real-life contexts was highly appreciated by both respondents, confirming that the integration of a contextual approach effectively made the instrument more accessible and engaging for users.
3. The instrument proved effective in measuring students' algebraic connection skills, with a classical completion rate of 79.4%. Furthermore, the instrument successfully generated stratified connection profiles for three student groups (KT, KS, KR), which can be directly utilized as a basis for targeted pedagogical decisions.

This research recommends three follow-up agendas. First, replication of similar instrument development for other mathematics topics (statistics, geometry, probability) using the CCD approach to build a construct-based national question bank. Second, experimental research comparing the impact of using CCD-based instruments and conventional instruments on the quality of teacher feedback and the long-term improvement of students' connection skills. Third, development of practical guidance for teachers in implementing CCD as a framework for developing daily formative assessment instruments, in line with the spirit of authentic assessment in the Independent Curriculum.

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