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Construction, Validity, and Reliability of the Pedagogical Competence Assessment Instrument for Proficient Teachers

Jusuf Blegur [1*], Andreas J. F. Lumba [1], Berliana [2], Intan Christine Adriani Siki [1], Harmawati [3], Alfred Tobok Siahaan [4], Haira [5], Vena Yuliana [5]

[1] *Physics Education, Health, and Recreation, Universitas Kristen Artha Wacana, Kupang 85228, Indonesia.*

[2] *Sport Education, Universitas Pendidikan Indonesia, Bandung 40150, Indonesia.*

[3] *Primary Teacher Education, Universitas Buana Perjuangan Karawang, Karawang 41361, Indonesia.*

[4] *Chemistry Education, Universitas Palangka Raya, Palangka Raya 74874, Indonesia.*

[5] *Early Childhood Education, Universitas Pendidikan Indonesia, Bandung 40150, Indonesia.*

Abstract

This study aims to develop and evaluate the Pedagogical Competence Assessment for Proficient Teachers (PCAI-PT) as an instrument for assessing teachers' pedagogical competence in Indonesia. The research employed a development method based on the ADDIE framework (Analyze, Design, Develop, Implement, and Evaluate). Thirteen pedagogical competence items representing core skills of novice expert teachers were formulated from document analysis. These items were validated by six expert raters and tested on 231 teachers across various educational levels. Validation results indicated that all PCAI-PT items were valid after revision, with Aiken's V ranging from 0.78 to 1.00. Intraclass correlation analysis showed increased inter-rater consistency from the initial validation to revalidation, demonstrating strong inter-rater reliability. Construct testing using CFA revealed that all items met the criteria, with factor loadings >0.70, Cronbach's alpha and composite reliability >0.70, and AVE >0.50. Discriminant validity was confirmed, and model fit indices indicated good to excellent fit (RMSEA = 0.088; SRMR = 0.034; CFI = 0.955). Concurrent validity testing using the Kruskal-Wallis test showed no significant differences across educational levels ($p>0.05$), indicating consistent application of the instrument. Overall, PCAI-PT is valid, reliable, and representative, providing a comprehensive and sustainable tool for assessing teachers' pedagogical competence across diverse educational contexts.

Keywords:

Pedagogical Competence Assessment;
Proficient Teachers;
Teacher Competency;
Instrument Validation;
Confirmatory Factor Analysis.

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1- Introduction

In Indonesia, the government has issued Regulation of the Directorate General of Teachers and Education Personnel Number 2626/B/HK.04.01/2023 on the Teacher Competency Model [1], which serves as an essential reference for developing teacher professionalism. This regulation updates the previous regulation, namely the Regulation of the Directorate General of Teachers and Education Personnel Number: 6565/B/GT/2020 concerning the Competency Model in Teacher Professional Development, which serves as a reference for teacher competency standards [2]. The 2020 regulation emphasized pedagogical, professional, social, and personal competencies as the main categories, with a focus on meeting formal standards and certification. However, this regulation was relatively static and did not emphasize adaptation to students' diverse needs or to developments in educational technology. The 2023 teacher competency model expands this framework by emphasizing teachers as reflective agents who not only meet formal standards but also

* **CONTACT**: jusufblegur@ukaw.ac.id

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evaluate, analyze, and design continuous improvements to learning practices. Furthermore, the 2023 teacher competency model holistically integrates pedagogical, professional, social, and personal competencies, emphasizing digital adaptation and responsiveness to students' learning needs. Therefore, the 2023 model is more contextually relevant and applicable to pedagogical practice in the modern education era than the 2020 regulations.

The 2023 teacher competency model regulation also specifically and systematically outlines the functional placement levels of teachers based on competency fulfillment, starting with Primary Expert, Junior/Proficient Expert, Middle Expert, and Main Expert. At the proficient teacher level, categorized as the third competency level, the focus of development is directed at gradations of intermediate competency mastery. This level emphasizes teachers' ability to evaluate, analyze, and design improvements to theoretical and practical principles in learning management. The teacher competency assessment instrument at this level includes indicators and sub-indicators that measure pedagogical, personality, social, and professional aspects, all oriented towards improving the quality of student-centered learning. The significance of developing this instrument lies in its function as an objective measuring tool for assessing teacher performance and readiness to face the challenges of 21st-century education, while simultaneously encouraging a reflective, innovative, and sustainable culture in the practice of teacher professionalism in Indonesia.

Pedagogical competence refers to a teacher's capacity to design, execute, and assess the learning process in an effective and efficient manner. It encompasses a comprehensive command of educational values and concepts, theoretical foundations, curriculum knowledge, classroom interaction, and a range of instructional skills [3]. Teachers are required to apply effective teaching methods and manage the learning process from the planning stage to evaluation [4, 5]. In addition, teachers with pedagogical competence must be able to evaluate the use of safe, comfortable, and effective learning strategies for students, including student-centered assessment, feedback, and reporting strategies, and design improvements [1, 6, 7]. Continuous improvement in the quality of teaching directly contributes to student learning achievement [8]. Strong pedagogical competence also enables teachers to adapt teaching strategies to the needs of different students, create an interactive learning environment, support active student participation, and encourage the development of critical thinking [3, 4]. In other words, pedagogical competence is the main foundation of teacher professionalism because it influences the effectiveness of learning and the achievement of educational goals [8].

The main problem in improving the quality of education lies in teacher quality, because quality learning can only be guaranteed by competent teachers [9, 10]. Therefore, evaluating the competency of proficient teachers requires up-to-date, valid, and reliable assessment instruments so that the results reflect the teacher's actual abilities according to professional demands. However, to date, many teacher competency assessment instruments still refer to outdated regulations and have not been adjusted to the Regulation of the Directorate General of Teachers and Education Personnel Number: 2626/B/HK.04.01/2023 concerning the Teacher Competency Model [1]. If these outdated instruments are still used in measuring, assessing, and evaluating the performance of proficient teachers, whether for competency mapping, promotion or demotion of functional positions, or the development of professional training programs, the resulting data will not represent ideal performance according to competency level. This condition has the potential to create bias in the evaluation, so that the resulting coaching and development recommendations are not on target [11, 12]. As a result, the goal of improving teacher professionalism and the quality of national education is difficult to achieve effectively and sustainably.

The development of teacher competency assessment instruments in Indonesia is not yet fully up to date in accordance with the latest regulations, including general competency assessment instruments [13]. The instrument developed by Panggabean & Himawan emphasizes aspects of pedagogy, classroom management, and student assessment. This instrument is quite supportive of classroom management and evaluation of learning outcomes, but does not explicitly assess teachers' abilities in integrating self-management, professional reflection, and pedagogical innovation that focuses on improving the quality of student-centered learning [14]. Continuing, Eliyawati et al. developed a science teacher competency assessment instrument for teaching Education for Sustainable Development (ESD), with a focus on content knowledge, content pedagogy, inquiry, professional practice, professional development, assessment and evaluation, and attitude [11]. Although this instrument is quite comprehensive in measuring mastery of content and professional practice, its orientation is still limited to mastery of material and general practice, so it does not emphasize teachers' abilities in evaluating and designing continuous learning improvements, which are the main characteristics of proficient teachers who are student-oriented.

Furthermore, Arikunto et al. also developed a teacher competency perception scale in Indonesia, which highlights pedagogical competencies related to knowledge of student characteristics, communication with students, and the ability to carry out learning assessments [15]. These findings are relevant for relationship management and assessment, but the instrument does not specifically assess teachers' ability to evaluate and design learning improvements systematically. More recently, Herman et al. have researched the pedagogical competence 4.0 model, which emphasizes instructional innovation, creativity, social interaction, and the application of technology-based pedagogy (Pedagogical 4.0) [16]. These findings demonstrate relevance to the development of modern pedagogical competencies, but still need to focus on evaluation and continuous improvement in student-centered learning practices, in accordance with the standards of

proficient teachers. Thus, overall, these findings indicate that although there have been efforts to measure pedagogical competency, teachers' ability to evaluate and design continuous learning improvements, which include mastery of theory-practice principles, professionalism, self-management, and relationships, is still not fully captured.

Table 1 shows a gap between existing instruments and the expected pedagogical competencies for proficient teachers, as defined by government standards, focusing on: a safe and comfortable learning environment for students; effective student-centered learning; and student-centered assessment, feedback, and reporting. Therefore, this study aims to construct and test the validity and reliability of an instrument that integrates all dimensions of proficient teachers' pedagogical competencies, thereby making teacher performance evaluations more comprehensive and objective, in line with the latest regulatory developments and 21st-century learning. This study is relevant and up-to-date, as the instrument's construction indicators and sub-indicators refer to the latest teacher competency model regulations, particularly at the proficient teacher functional level [1, 6, 7]. Teachers at this level (proficient) must demonstrate proactive performance in evaluating and designing continuous competency improvements, enabling them to adapt learning strategies to students' ever-changing learning needs. Therefore, this instrument is not only valid and reliable, but also aligns with modern teacher professional practices and is relevant for their ongoing capacity development.

Table 1. Strengths and limitations of previous studies (development of teacher pedagogical competency instruments)

No.	Author	Indicator focus	Strengths	Limitations
1	Panggabean & Himawan [14]	Pedagogy, classroom management, student assessment	Supports classroom management and the evaluation of learning outcomes	Does not assess aspects of self-management, professional reflection, or pedagogical innovation; not yet focused on continuous instructional improvement
2	Eliyawati et al. [11]	Content knowledge, content pedagogy, inquiry, professional practice, professional development, assessment, attitude	Comprehensive for content mastery and professional practice; includes ESD aspects	Still oriented toward subject-matter mastery and general practice; insufficiently evaluates the ability to design sustainable instructional improvements
3	Arikunto et al. [15]	Knowledge of student characteristics, communication, learning assessment	Supports the assessment of teacher-student relationships and assessment skills	Does not evaluate instructional processes systematically nor the ability to design improvements
4	Herman et al. [16]	Instructional innovation, creativity, social interaction, educational technology	Emphasizes modern innovation, creativity, and technology-based pedagogy	Does not yet focus on reflective evaluation or continuous improvement based on student needs

2- Method

This study aims to construct, test the validity, and test the reliability of the pedagogical competency assessment instrument for proficient teachers, using the research and development method with the Analyze, Design, Develop, Implement, and Evaluate (ADDIE) protocol [17] (see Figure 1).

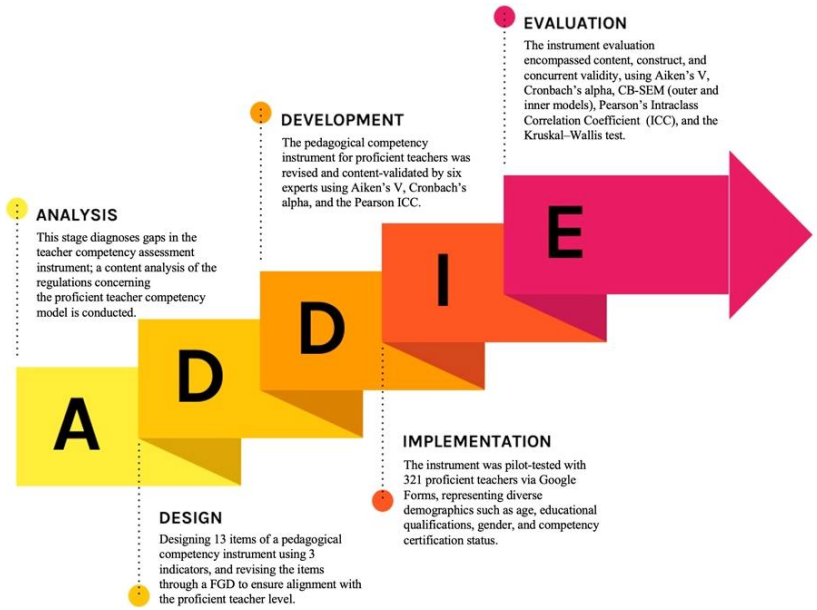

Figure 1. Research procedure

2-1- Analysis

This stage is the process of diagnosing performance gaps to justify the urgency and novelty of the research. The researchers began by analyzing trends in teacher competency assessment instruments using bibliometric studies. They found that no published articles had successfully developed competency assessment instruments for proficient teachers in accordance with the latest regulations on teacher competency models.

Furthermore, the researchers also analyzed the content of regulations and teacher competency guidebooks, including: academic qualification standards and teacher competencies [18], teacher competency models [1], operational guidelines for teacher competency models [6], and supporting modules for teacher competency models [7]. As a result, the government has divided teacher functional placement levels according to competency fulfillment at each level, with proficient teachers at competency level three, with an intermediate level of competency mastery. This level of competency mastery is reflected in teachers' capacity to critically evaluate and refine their understanding of both theoretical and practical principles related to learning management, professional knowledge, self-regulation, and interpersonal management, all of which contribute to enhancing the quality of student-centered instruction.

A detailed explanation of the specific needs analysis stage was published in September 2025 in the Journal of Progressive Education under the title "*Bridging policy and practice in competency assessment of Indonesian proficient teachers: A mixed methods gap analysis*" [19].

2-2- Design

Referring to the results of the needs analysis, researchers designed an instrument using concepts, indicators, and sub-indicators from the latest regulations on teacher competency models [1, 6, 7], especially on pedagogical competency. This competency emphasizes teachers organizing their abilities in managing student-centered learning to achieve learning objectives.

This pedagogical competence is developed from three leading indicators, namely: (1) a safe and comfortable learning environment for students (3 sub-indicators), (2) effective student-centered learning (5 sub-indicators), and (3) student-centered assessment, feedback, and reporting (5 sub-indicators), which are designed into 13 statement items, with the composition of items in each sub-indicator totaling one item, which is packaged in a seven-point Likert scale (see Table 2). These three indicators are integrated to form a cohesive model of pedagogical competence for proficient teachers. At this level, teachers are not only able to apply pedagogical practices, but also evaluate, analyze, and design improvements to the theoretical principles and practices of learning management.

Table 2. Instrument design blueprint

No.	Indicators	Sub-indicators competency	Total of items
1	Safe and comfortable learning environment for students	a. Managing difficult student behavior	1 item
		b. Classroom management to achieve student-centered learning	1 item
		c. Student safety and comfort during the learning process	1 item
2	Effective, student-centered learning	a. Structured and sequential learning design to achieve learning objectives	1 item
		b. Learning design that is relevant to the school's environment by involving students	1 item
		c. Selection and use of learning resources appropriate to learning objectives	1 item
		d. Learning instructions that include strategies and communication to foster student interest and critical thinking	1 item
		e. Adaptive use of information and communication technology (ICT) in learning	1 item
3	Student-centered assessment, feedback, and reporting	a. Designing student-centered assessments	1 item
		b. Implementing student-centered assessments	1 item
		c. Feedback to students regarding their learning	1 item
		d. Preparing student learning achievement reports	1 item
		e. Communicating student learning achievement reports	1 item

A safe learning environment serves as a foundation for teachers to assess the quality of the classroom climate and identify factors that influence their students' learning comfort. In this context, teachers can analyze the effectiveness of student-centered learning strategies and design adjustments based on students' actual needs. Furthermore, assessments oriented toward student development provide teachers with data to evaluate learning processes and outcomes, provide more insightful and reflective feedback, and establish responsive remedial measures. It means that these three indicators not only work side by side but are also integrated into the pedagogical competency model of proficient teachers who are professional, adaptive, and sustainable through a continuous, mutually reinforcing cycle that leads to transformational change.

The researchers then conducted a Focus Group Discussion (FGD) with a panel of panelists to revise the design formulation of 13 statement items that could manifest indicators and sub-indicators of proficient teacher competency. Based on the FGD results, several inputs, revisions, and item eliminations were made to facilitate teachers' understanding and interpretation of items that could represent their performance at the intermediate competency level (evaluation and designing improvements).

2-3- Develop

The revised proficient teacher competency assessment instrument entered initial validation (content validation). Six raters participated from various expertise backgrounds, such as curriculum, physical education, psychometrics, and teacher competency (see Table 3). Content validity was tested using the Aiken-V formula using acceptance criteria of ≥ 0.78 [20], Cronbach alpha reliability testing using criteria of ≥ 0.70 [21], and inter-rater reliability from Pearson's ICC using criteria of ≥ 0.50 [22]. Researchers conducted revalidation to follow up on various rater feedback and input until it met the parameters for content validity and reliability testing.

Table 3. Rater committee

No.	Education	Gender	Age and work experience	Expertise	Affiliation
1	Prof., M.S., Ph.D.	Male	50/24	Physical education	Universitas Negeri Yogyakarta
2	Prof., Dr., M.Pd.	Male	65/41	Physical education curriculum	Universitas Pendidikan Indonesia
3	Prof., Dr., M.Pd.	Male	60/33	Physical education	Universitas Syiah Kuala
4	Dr., M.Pd.	Male	37/10	Tests and measurement	Universitas Negeri Padang
5	Dr., M.Pd.	Male	37/10	Lesson study	Universitas Sriwijaya
6	S.Pd., M.M.	Female	37/11	Teacher competence	Education Quality Assurance Center, East Nusa Tenggara Province

2-4- Implement

Implementation involved piloting the instrument construction on 321 proficient teachers (M±SD = 40.38±8.40) with work experience (M±SD = 12.26±7.24). Researchers provided the instrument via Google Form and disseminated it to teachers in Indonesia. Respondents were selected through a convenience sampling approach, involving individuals who were readily accessible and willing to participate in the study via a Google Forms survey [23, 24]. Respondents responded to the instrument using a seven-point Likert scale.

The demographic details of the respondents are as follows: First, there were 138 male teachers (42.99%), while there were 183 female teachers (57.01%). Second, there were 127 elementary school teachers (39.56%), 133 junior high school teachers (42.43%), and 61 high school teachers (19.00%). Third, there are 44 non-civil servant teachers (13.71%), 179 civil servant teachers (55.76%), and 88 government employee teachers with work agreements (P3K) (27.41%). Fourth, there are eight diploma teachers (2.49%), 269 bachelor teachers (83.80%), 43 master teachers (13.40%), and one doctoral teacher (0.31%). Finally, there are 73 teachers (22.74%) who have not received competency certification, while there are 248 teachers (77.26%).

2-5- Evaluate

The evaluation process involves selecting appropriate assessment tools and establishing criteria for interpreting the results in order to determine the instrument's quality across the analyze, design, and develop stages (content validity and reliability), as well as the implement stage (construct validity, reliability, and concurrent validity). These procedures were supported by Microsoft Excel, SmartPLS, and SPSS. Content validity was examined using Aiken's V formula [20] employing six expert raters and four rating categories to apply a minimum acceptable coefficient of ≥0.78. Content reliability was assessed through Cronbach's alpha, using ≥ 0.70 as the threshold [21], while inter-rater reliability was evaluated via Pearson's ICC, adopting ≥ 0.50 as the criterion for adequacy [22].

Construct validity and reliability were examined using CB-SEM analysis, guided by several established criteria. First, each item was required to meet a loading factor threshold of greater than 0.70 [25-27]. Reliability was assessed through Cronbach's alpha and composite reliability, both of which were expected to exceed 0.70 [21, 28], while convergent validity was confirmed using the Average Variance Extracted (AVE), with acceptable values above 0.50 [28], Discriminant validity was further evaluated using the Fornell-Larcker criterion, ensuring that the square root of the AVE for each construct exceeded its inter-construct correlations [29]. In addition, model fit was assessed through a series of goodness-of-fit indicators, including a Chi-square/df value below 3, a Root Mean Square Error of Approximation (RMSEA) below 0.08, a Standardized Root Mean Square Residual (SRMR) below 0.10, and fit indices—Normed Fit Index (NFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI)—all exceeding 0.90 [21, 28, 30].

In the concurrent validity test, the researcher did not correlate the construction of the new teacher competency instrument with the previous teacher competency instrument. The reason is that the previous instrument did not group teacher competencies *based* on their functional level. Therefore, the concurrent validity test used Kruskal-Wallis by comparing the competencies of proficient teachers based on educational level units (elementary school, junior high school, and senior high school). If there is no difference between the three sample groups (sig. >0.05), then the instrument meets concurrent validity because both sample groups agree on the items of the teacher pedagogical competency instrument construction.

3- Results and Discussion

This section delineates the analytical procedures undertaken to establish the quality of the research instrument through a comprehensive series of validity and reliability assessments. The analyses encompass content validity and reliability, which evaluate the alignment of the indicators with the constructs under investigation; construct validity and reliability, which examine the precision and consistency of the measurements; overall goodness-of-fit analyses, which determine the adequacy of the proposed model; and concurrent validity testing, which explores the relationships between different sample groups and the outcomes of the newly developed scale. Collectively, these evaluations provide the empirical foundation for affirming that the research model is both feasible and dependable for subsequent hypothesis testing. The section concludes with a discussion that situates the study's findings within the context of existing literature.

3-1- Content Validity and Reliability

The results of the first phase of content analysis (the original version), conducted by six validators on the proficient teacher competency assessment instrument, indicated that the instrument had excellent content validity. Of the 13 assessment scores provided, the scores ranged from 0.67 to 1.00, with an average score of approximately 0.91 (see Table 3). It indicates that the validators generally considered the instrument's items relevant, appropriate, and suitable for use. However, several lower scores, such as 0.67 and 0.78, indicated that some items may need to be reviewed or refined to optimize the instrument.

Based on the validation results and the rating committee's notes, the researchers revised and revalidated the instrument. In the second phase of developing the proficient teacher competency assessment instrument, the results of the content analysis conducted by the six validators indicated a significant improvement in the instrument's content validity. Of the 13 validation scores collected, the scores ranged from 0.78 to 1.00, with an average score of approximately 0.94 (see Table 4). The validators generally gave a very positive assessment of the instrument's content suitability and appropriateness. Most scores were above the maximum value of 1.00, representing approximately 61% of the total assessments. It reflects that nearly all items in the instrument have optimally met content validity criteria and are ready for use. Although there were a few slightly lower scores, at 0.78, these were very limited and did not significantly impact the instrument's overall validity. It indicates that the revisions and refinements made after the first phase successfully improved the quality of the Pedagogical Competency Assessment Instrument for Proficient Teachers (PCAI-PT). This second phase demonstrated excellent and consistent content validity. This instrument is ready for further testing or field implementation.

Table 4. Aiken validity (original and revision version)

Original version				Revision version			
Scale	**M±SD**	**Aiken-V**	**Decision**	**Scale**	**M±SD**	**Aiken-V**	**Decision**
Item 1	3.33±0.52	0.78	Valid	Item 1	3.33±0.52	0.78	Valid
Item 2	3.33±0.82	0.78	Valid	Item 2	3.33±0.52	0.78	Valid
Item 3	3.83±0.41	0.94	Valid	Item 3	3.83±0.41	0.94	Valid
Item 4	4.00±0.00	1.00	Valid	Item 4	4.00±0.00	1.00	Valid
Item 5	3.83±0.41	0.94	Valid	Item 5	4.00±0.00	1.00	Valid
Item 6	4.00±0.00	1.00	Valid	Item 6	4.00±0.00	1.00	Valid
Item 7	4.00±0.00	1.00	Valid	Item 7	4.00±0.00	1.00	Valid
Item 8	3.67±0.82	0.89	Valid	Item 8	4.00±0.00	1.00	Valid
Item 9	3.50±0.84	0.83	Valid	Item 9	4.00±0.00	1.00	Valid
Item 10	3.00±0.89	0.67	Invalid	Item 10	3.33±0.52	0.78	Valid
Item 11	3.83±0.41	0.94	Valid	Item 11	4.00±0.00	1.00	Valid
Item 12	4.00±0.00	1.00	Valid	Item 12	4.00±0.00	1.00	Valid
Item 13	4.00±0.00	1.00	Valid	Item 13	4.00±0.00	1.00	Valid

In addition to validity testing, researchers also conducted Cronbach's alpha and Pearson's intraclass correlation coefficient (ICC) reliability tests. In stage 1, the reliability value was 0.643 (0.70) and the inter-rater reliability value was 0.231 (0.50), so both test results were classified as poor. Following up on the validity and reliability results, researchers then revised the items according to the rater committee's notes. They sent them back to them to conduct validity and reliability testing of the scale content (revalidation). As a result, the reliability value increased to 0.851, so it was categorized as very good (0.8 to 0.9) [21]. Meanwhile, the inter-rater reliability value increased to 0.488, which is included in the poor category (< 0.50-0.75) [22], but if we use other norms from Cicchetti, then for social sciences it is classified as fair, namely 0.40-0.59 [31] (see Table 4). Thus, of the 13 items of the proficient teacher competency

assessment instrument that were successfully developed, all have successfully met the criteria for content validity and reliability testing. The ANOVA test results also proved that the six rater committees showed significant differences in the scale assessment in the first stage (validation) (< 0.001 < 0.05). Likewise, the second stage of testing (revalidation) showed significant differences (<0.001 < 0.05) (see Table 5).

Table 5. Pearson intraclass correlation coefficient

	Intraclass correlation[b]		F test with true value 0			
			Value		Significance	
	Validation	Revalidation	Validation	Revalidation	Validation	Revalidation
Single measure	0.231[a]	0.488[a]	2.804	6.724	0.004	<0.001
Average measure	0.643[c]	0.851[c]	2.804	6.724	0.004	<0.001

Two-way mixed effects model where people effects are random and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present or not.

b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

The researcher captured several assessor notes during the validation and revalidation stages as follows (see Table 6). In item 1, rater 1 (male/50 years old) noted that "*This difficult behavior is ambiguous, requiring the use of more precise terms*." Furthermore, Rater 3 (male/60 years old) stated, "*Regularly evaluating strategies for managing difficult learning behavior is an important step in ensuring the effectiveness of the approach used in dealing with student behavior*." The rater considered the term difficult behavior as ambiguous and needed to be replaced with a more operational term. In addition, it was suggested that the item include the importance of evaluating student behavior management strategies as part of the effectiveness of the learning approach. In item 2, rater 1 (male/50 years old) explained, "*Student variation and interaction do not guarantee student-centered learning*." Furthermore, rater 3 (male/60 years old) explained, "*By presenting various methods and approaches, teachers can reach various student learning styles so that the learning process becomes more dynamic and interesting. Therefore, efforts to design new, varied strategies greatly support the creation of effective and enjoyable learning*." Raters highlighted that a variety of methods and student interactions do not automatically guarantee a student-centered approach. Therefore, items are recommended to clarify that strategy variations should be geared toward meeting individual learning needs to make learning more effective and meaningful.

Table 6. Pedagogical Competency Assessment Instrument for Proficient Teachers (PCAI-PT)

No.	Original version	Revision version
1	I regularly evaluate strategies for managing students' learning difficulties.	I regularly evaluate learning models to address barriers to students' analytical thinking.
2	I design new, more varied strategies to increase student interaction during learning.	I design differentiated learning that encourages students to explore their potential according to their learning styles.
3	I evaluate teaching skills to create a sense of safety and comfort for students during learning.	I evaluate learning approaches to minimize potential physical and non-physical hazards in the learning environment.
4	I regularly evaluate the sequence of learning designs to support learning objectives in accordance with the latest curriculum.	I regularly evaluate the sequence of learning designs to support learning objectives in accordance with the latest curriculum.
5	I actively involve (collaborate) with students when designing learning.	I actively collaborate with students when designing learning.
6	I evaluate the learning resources used to ensure the effectiveness of achieving learning objectives.	I evaluate learning resources used to ensure the effectiveness of achieving learning objectives.
7	I evaluate communication strategies to enhance students' critical thinking.	I evaluate communication strategies to enhance students' critical thinking.
8	I evaluate the use of technology to improve learning effectiveness.	I evaluate the use of adaptive technology to improve the quality of learning.
9	The assessments I design are relevant to students' needs.	I design assessments that allow students to choose the format of final assignments according to their interests.
10	I improve assessment implementation based on student reflections.	I evaluate the use of peer assessments to enhance students' critical thinking in formative assessments.
11	I evaluate the effectiveness of feedback on improving student learning outcomes.	I evaluate the effectiveness of feedback on improving student learning outcomes.
12	The learning achievement reports I create are aligned with student progress.	I create learning achievement reports based on student progress.
13	I convey learning achievement reports transparently to students and parents.	I convey learning achievement reports transparently to students and parents.

In item 3, rater 4 (male/37 years old) offered this indicator, formulated as follows: "*I evaluate learning approaches to minimize potential physical and non-physical hazards in the learning environment.*" Meanwhile, rater 6 (female/37 years old) added, "*Students' sense of safety may be linked to the physical, social-emotional, and academic safety that teachers expect to create in the classroom*." Feedback from raters demonstrated the importance of adding an evaluation element to learning approaches to create a physically and non-physically safe learning environment. This safety encompasses physical, social-emotional, and academic aspects. In item 5, rater 5 (male/37 years old) noted,

"*Participatory. Need for language consistency: remove parentheses.*" Consistency in language use is needed, particularly by removing irrelevant parentheses, to make the item clearer and more professional.

In item 8, rater 5 (male/37 years old) explained, "*Relevant, but the type of technology can be clarified if needed for a specific context*." The item was deemed relevant, but it was recommended that the type of technology be clarified to suit the learning context and student needs. In item 9, rater 1 (male/50 years old) explained, "*Assessment that is relevant to student needs is not necessarily student-centered. Consider developing assessments that involve students, formative assessments, assessments for learning, performance-based assessments, and authentic assessments*." The rater noted that relevant assessments are not necessarily student-centered. Therefore, the item is recommended to focus on the use of formative, participatory, and authentic assessments that enable active student involvement. In item 10, rater 6 (female/37 years old) explained, "*It is best to evaluate the assessment implementation first before making improvements. Adjusting the logical sequence of the items is necessary*." The rater suggested that the evaluation of the assessment implementation should be conducted before making improvements.

3-2- Construct Validity and Reliability

After fulfilling the validity and reliability values of the content, the researchers continued testing the scale, Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT), on 321 teachers spread throughout Indonesia to assess the validity and reliability of its construct (outer model) with Covariance Based-Structural Equation Model (CB-SEM) analysis. Referring to two SEM analysis approaches, namely PLS-SEM and CB-SEM, the CB-SEM method is considered more appropriate in producing factor-based model fit indices. CB-SEM is also superior when applied to large sample sizes, because it is able to provide more accurate and valid model estimates compared to PLS-SEM [32, 33]. Furthermore, CB-SEM serves to confirm the theory by assessing the extent to which the theoretical model is able to replicate the covariance matrix of the observed sample data [34]. In addition, this data analysis method can also be used to estimate models involving composites, thus expanding its application in complex structural analysis [35, 36]. Thus, CB-SEM is very appropriate for testing reflective constructs and relationships between latent constructs, while also enabling evaluation of the model's goodness-of-fit through indices such as Chi-square, CFI, TLI, RMSEA, and SRMR. This method also provides reliable, efficient, and consistent parameter estimates, thereby validating the relationships among the dimensions of comprehensive pedagogical competence, ensuring that the tested model truly reflects the cohesive structure of proficient teachers' pedagogical competence.

A total of thirteen (13) items that underwent construct validity and reliability testing using CB-SEM analysis demonstrated satisfactory psychometric properties. Specifically, all items exceeded the loading factor threshold of 0.70, ranging from 0.713 to 0.894 [25-27] (see Figure 2). Reliability analyses further confirmed the robustness of the instrument, with Cronbach's alpha values ranging from 0.861 to 0.924 and composite reliability scores between 0.884 and 0.923, all above the recommended cutoff of 0.70 [21, 25-28]. Additionally, the Average Variance Extracted (AVE) for all items exceeded 0.50, with values spanning 0.621 to 0.712 [28] indicating strong convergent validity. The Fornell-Larcker criterion for discriminant validity also confirmed that the Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT) met the required parameters, with values ranging from 0.788 to 0.844 [28, 29] (see Table 7). Collectively, these results suggest that each manifest variable contributes effectively to the covariance structure of its corresponding latent variable, demonstrating that the developed items reliably represent the constructs they are intended to measure.

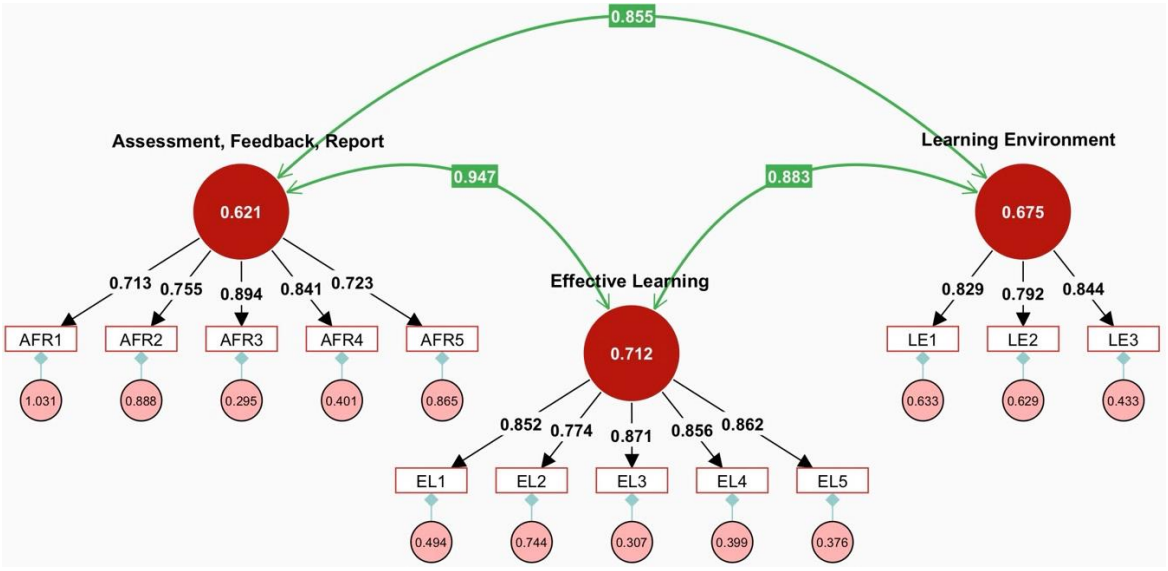

Figure 2. Path diagram (PCAI-PT)

Table 7. Construct validity and reliability

Indicator	Cronbach alpha	Composite reliability	AVE	Discriminant validity
Learning environment	0.861	0.884	0.675	0.822
Effective learning	0.924	0.923	0.712	0.844
Assessment, feedback, report	0.890	0.886	0.621	0.788

3-3- Goodness of Fit Test (GoF)

The purpose of the Goodness-of-Fit (GoF) test is to determine whether the proposed model sufficiently represents the observed data and its underlying multivariate structure [28]. The results indicate that the model's fit indices vary in their alignment with recommended thresholds. The Chi-Square/df ratio is 3.481, slightly exceeding the suggested maximum of 3.00, and the Root Mean Square Error of Approximation (RMSEA) is 0.088, marginally above the acceptable cutoff of 0.08. Meanwhile, the Standardized Root Mean Square Residual (SRMR) value of 0.034 falls well below the 0.10 threshold, demonstrating a good fit. In addition, the Normed Fit Index (NFI) of 0.938, the Tucker-Lewis Index (TLI) of 0.944, and the Comparative Fit Index (CFI) of 0.955 all surpass the recommended minimum value of 0.90, further supporting the adequacy of the model (see Table 8).

Table 8. Goodness of fit test

	Estimated model	Null model	Interpretation
Chi Square/df	3.481	44.994	Moderate fit
Root Mean Square Error of Approximation (RMSEA)	0.088	0.370	Moderate fit
Standardized Root Mean Square Residual (SRMR)	0.034	n/a	Excellent fit
Normed Fit Index (NFI)	0.938	n/a	God fit
Tucker-Lewis Index (TLI)	0.944	n/a	God fit
Comparative Fit Index (CFI)	0.955	n/a	Excellent fit

The Chi-Square/df value of 3.481 is slightly above the ideal limit (3), but still below the tolerance limit (5) often used in social research [25, 37]. This model demonstrates a generally good fit, with slight deviations in the Chi-Square/df and RMSEA, but other indicators support adequate model fit. The deviations in the Chi-Square/df and RMSEA are due to the limited sample size. With n > 200, even small differences between the data and the model can significantly increase the Chi-Square value, causing the χ^2/df ratio to exceed the ideal range (e.g., to 3-4). Therefore, a value of 3.481 for a sample of 321 is not a sign of a poor model; it simply indicates minor imperfections, which are almost always present in real-world data [21, 28, 30].

Thus, the statement items constructed in the Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT) still have appropriate psychometric properties to measure actual conditions, or the projected model has high actual values when implemented.

3-4- Concurrent Validity

Normality testing was conducted to determine whether the data for each research variable were normally distributed. This test used two methods: the Kolmogorov-Smirnov and the Shapiro-Wilk test, which demonstrated that all research variables at each educational level had a significance value <0.05 (see Table 9). It indicated that the data for the learning environment, effective learning, assessment, feedback, and report variables at the elementary, middle, and high school levels were not normally distributed. Therefore, in subsequent data analysis, the researchers employed non-parametric analysis techniques.

The Kruskal-Wallis test was used to identify whether the developed Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT) offered the projected learning experience (task performance) idealized by proficient teachers at the elementary, middle, and high school levels. This test also examined whether they differed or whether they demonstrated similar agreement on the formulation of the scale items.

Based on the results of the homogeneity test using Levene's test, the significance value (Sig.) for all variables was greater than 0.05, respectively: learning environment (0.346), effective learning (0.395), assessment, feedback, and report (0.591), and total (0.425) (see Table 10). It indicates that there is no significant difference in variance between groups, so that the data on all variables can be declared homogeneous. Thus, the assumption of homogeneity of variance has been met, and the data are suitable to proceed to the analysis stage of different tests (such as ANOVA) because the variance between groups is in a balanced condition.

Table 9. Tests of normality

	Level of educational unit	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Learning environment	Elementary school	0.130	127	0.012	0.933	127	0.002
	Junior High School	0.176	133	<0.001	0.829	133	<0.001
	Senior High School	0.144	61	0.003	0.876	61	<0.001
Effective learning	Elementary school	0.121	127	0.027	0.891	127	<0.001
	Junior High School	0.153	133	0.001	0.879	133	<0.001
	Senior High School	0.157	61	<0.001	0.829	61	<0.001
Assessment, feedback, report	Elementary school	0.113	127	0.053	0.900	127	<0.001
	Junior High School	0.174	133	<0.001	0.856	133	<0.001
	Senior High School	0.146	61	0.002	0.850	61	<0.001
Total	Elementary school	0.101	127	0.193	0.907	127	<0.001
	Junior High School	0.148	133	0.002	0.861	133	<0.001
	Senior High School	0.139	61	0.005	0.835	61	<0.001

a. Lilliefors significance correction

Table 10. Tests of homogeneity

		Sum of squares	df	Mean square	F	Sig.
Learning environment	Between groups	26.039	2	13.019	1.064	0.346
Effective learning	Between groups	56.167	2	28.083	0.931	0.395
Assessment, feedback, report	Between groups	32.060	2	16.030	0.527	0.591
Total	Between groups	315.837	2	157.918	0.858	0.425

Referring to the prerequisite tests, although the homogeneity test was met, the four data groups did not meet the normality test, so non-parametric statistical testing was performed. The Kruskal-Wallis test results showed that the asymptotic significance value for the learning environment variable was 0.602, effective learning was 0.565, assessment, feedback, and report were 0.666, and the total score was 0.524 (see Table 11). All significance values were greater than 0.05, thus concluding that there were no significant differences between the respondent groups at each educational level (elementary school, junior high school, and senior high school) regarding the Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT), either in terms of indicators or overall variables studied.

Table 11. Kruskal-Wallis test based on educational unit level

	Learning environment	Effective learning	Assessment, feedback, report	Total
Kruskal-Wallis H	1.015	1.143	0.814	1.292
df	2	2	2	2
Asymp. sig.	0.602	0.565	0.666	0.524
Conclusion	Not significant	Not significant	Not significant	Not significant

a. Kruskal Wallis test

b. Grouping variable: Educational unit level

The test results above indicate that teacher or respondent perceptions of the learning environment, learning effectiveness, and the assessment, feedback, and reporting processes that represent the pedagogical competence of proficient teachers were relatively uniform across all educational levels. The absence of significant differences indicates that the formulation of these learning components has been implemented with a moderate level of fit for the pedagogical competencies of proficient teachers at each level. This finding also reinforces the view that teachers agree that policies and evaluations of learning practices implemented at various levels of education tend to adhere to similar standards and principles, particularly following the implementation of the independent curriculum, which emphasizes flexibility, reflection, and collaboration in the learning process.

3-5- Discussion

3-5-1- Main Research Findings

The results showed that the PCAI-PT instrument is valid and reliable in measuring teachers' pedagogical competence. Of the 13 items tested, all were valid after revision with Aiken-V 0.78-1.00, indicating improved item quality and good

representation of latent variables. Intraclass correlation analysis confirmed strong inter-rater consistency, indicating high reliability across rater backgrounds. Through CB-SEM, all items met the criteria for convergent validity (factor loading > 0.70; Cronbach's alpha and composite reliability > 0.70; AVE > 0.50) and good discriminant validity. The model also showed moderate to excellent goodness-of-fit (χ^2/df = 3.481; RMSEA = 0.088; SRMR = 0.034; CFI = 0.955), confirming the model's statistical validity. Thus, the Kruskal-Wallis test showed no significant differences based on educational level ($p > 0.05$), indicating that the instrument can be used consistently across educational levels. This finding is important because it demonstrates the flexibility of the PCAI-PT instrument in assessing teacher pedagogical competence at different educational levels, from elementary to secondary, without compromising measurement accuracy. Overall, the PCAI-PT has proven accurate, reliable, and flexible in assessing teacher pedagogical competence across various educational contexts.

3-5-2- Comparison with Prior Studies

Various teacher competency assessment instruments have been developed with varying focuses. Panggabean & Himawan emphasized aspects of pedagogy, classroom management, and assessment [14]. Meanwhile, the instrument developed by Eliyawati et al. assessed science teacher competency in the context of Education for Sustainable Development (ESD) through the dimensions of content mastery, pedagogy, inquiry, professional practice, and attitude. Still, it did not emphasize the ability to design continuous learning improvements [11]. The teacher competency perception scale instrument, created by Arikunto et al. focused on understanding student characteristics, communication, and learning assessment [15]. Furthermore, the pedagogical competence 4.0 model studied by Herman et al. emphasized instructional innovation, creativity, social interaction, and technology integration [16]. Examining various previous instruments tended to measure technical aspects of teaching and classroom management, but still did not highlight aspects of continuous evaluation and systematic improvement of learning practices, so they did not fully address the gap in teacher competency assessment in Indonesia. In fact, designing improvements based on learning evaluations is a key performance characteristic of student-centered proficient teachers, as stipulated in the Directorate General of Teachers and Education Personnel Regulation Number 2626/B/HK.04.01/2023 concerning the Teacher Competency Model [1].

Compared with these previous findings, the PCAI-PT has significant advantages. First, this instrument not only measures mastery of content and pedagogical techniques but also encompasses teachers' ability to evaluate learning practices and design continuous improvement, which are hallmarks of proficient teachers as mandated by the Indonesian government [1, 6, 7]. Second, the PCAI-PT has undergone robust validity and reliability testing, including construct, convergent, discriminant, and inter-rater reliability. It demonstrates that this instrument is not only theoretically valid but can also be implemented practically with a high degree of consistency. Third, the flexibility of the instrument in being applied at various levels of education (primary school to high school) shows the potential for its widespread use, so that it can become a national standard tool for assessing teacher pedagogical competence. Thus, it is clear that the PCAI-PT is more contextual, reflecting current regulatory expectations, meeting actual teacher performance needs, and supporting improved learning outcomes [19] through mastery of proficient teacher competencies, namely teachers must have the ability to evaluate and design improvements to a safe and comfortable learning environment for students, effective student-centered learning, and student-centered assessment, feedback, and reporting.

Not only that, but this instrument also strengthens the content of teachers' pedagogical competencies that emphasize the theory of needs, humanism, constructivism, and transformative pedagogy to create a safe and comfortable learning environment, student-centered learning, and formative assessment and feedback, which received strong support in the current literature. Recent research shows that students' perceptions of school/classroom climate are significantly related to well-being and learning outcomes, emphasizing the importance of a safe and supportive psychosocial environment [38]. In the context of student-centered learning, studies on motivation, mindset, and classroom climate show that when students perceive a supportive classroom climate, students with a "growth mindset" show higher levels of engagement and learning goal orientation [39]. Regarding assessment and feedback, contemporary literature emphasizes assessment practices as a key strategy to improve learning. Rapid, specific, and ongoing feedback helps students improve their learning process, and teachers provide scaffolding as needed [40]. In addition, empirical research shows that teacher feedback during oral reading has a significant impact on student achievement, underscoring that the quality of teacher-student interactions and textual/verbal feedback remains an integral part of learning theory [41].

3-5-3- Three Standard Indicators of Teacher Pedagogical Competence in Indonesia

As previously discussed, the government recommends three main indicators for measuring, assessing, and evaluating teachers' pedagogical competence. First, managing difficult student behavior requires an empathetic and solution-oriented approach. Teachers need to understand the background of this behavior, implement classroom management oriented towards positive discipline, restorative communication, and provide emotional support so that students feel trusted and valued [42, 43], so they can improve themselves without fear or pressure to increase their motivation and competence [44, 45]. Classroom management to achieve student-centered learning is carried out by creating active and collaborative interactions. Teachers become facilitators who encourage participation, provide space for different learning styles, and adapt learning methods to individual needs [46, 47]. Classes are no longer centered on the teacher, but on meaningful student learning experiences [42, 48].

A sense of safety and comfort for students is the main foundation for successful learning. Teachers must foster an atmosphere of mutual respect, free from intimidation, discrimination, and violence. When students feel physically and emotionally safe, they are more confident in expressing themselves, expressing their opinions, and actively participating in the learning process [43, 49]. A positive learning environment can be cultivated in a holistic and sustainable manner. Recent studies have extended this discussion beyond the physical design of school spaces to examine how such environments can promote inclusivity and ensure psychological safety for all learners [50]. Consequently, at the proficient level of teacher competency, educators are expected to possess the ability to critically evaluate and refine the safety and comfort of the learning environment. This involves continuously engaging with current research and drawing on best practices shared by colleagues to enhance the overall quality of student-centered learning.

Second, effective learning design must be structured and sequential so that each stage of the learning activity systematically leads to the achievement of learning objectives [51, 52]. Teachers need to design the flow of activities from introduction, core, to conclusion, taking into account the students' ability levels and the learning outcomes mandated by the government. Furthermore, learning design must be relevant to the conditions surrounding the school and actively involve students, including using design by research, which is centered on the principles of authentic tasks [53]. The local context is used as a source of inspiration, so that learning feels real, meaningful, and encourages emotional involvement of students [54], including using local wisdom materials to improve student literacy and numeracy [55], mathematical logical intelligence [56], strengthen Pancasila student profiles (P5) [57], and student learning outcomes [58].

Teachers need to select the use of learning resources that are relevant to competencies and learning objectives. Learning resources can be books, the surrounding environment, digital media, or sources from the community. Next, learning instructions are delivered using strategies that foster students' interest, curiosity, and critical thinking skills. Two-way communication and interactive methods such as discussions, projects, or case studies are crucial. Finally, information and communication technology (ICT) is used adaptively to expand learning access and enhance creativity. With a holistic and contextual design, the learning process will be more lively, engaging, and oriented toward developing 21st-century competencies. For example, several studies have integrated the use of AI to develop lesson plans, authentic assignments, and so on [59, 60]. Finally, at the proficient teacher competency level, teachers must have the ability to evaluate and design improvements to effective, learner-centered learning through ongoing research studies and peer best practices to enhance the quality of learner-centered learning.

Third, designing learner-centered assessments begins with developing assessment instruments that measure competencies holistically, encompassing knowledge, skills, and attitudes developed from learning outcomes and learning objectives, thus making them relevant to teachers' instructional planning [61, 62]. Assessments are designed to provide opportunities for students to demonstrate mastery and expansion of competencies [63, 64] through various means, such as scales, tests, observation guides, projects, portfolios, or self-reflection, and so on. Furthermore, assessments are conducted fairly, transparently, and support a positive learning atmosphere to encourage students to become familiar with test results for continuous self-improvement [65]. Teachers act as facilitators who monitor the learning process and outcomes, not simply assess the final product. Therefore, teachers must think, use, and develop assessment criteria to avoid practices that are considered trivial, which may not be beneficial for student learning (achievement of learning objectives) [66].

In the process, feedback to students is an important part of helping them understand their strengths and areas for improvement. Therefore, teacher feedback must be constructive and specific, encouraging students to improve their learning strategies and fostering intrinsic motivation [67, 68]. Not only that, after the assessment, teachers need to compile a comprehensive report on student learning outcomes, describing individual development based on concrete evidence from the learning process. Finally, communication of learning achievement reports is carried out openly to students and parents using positive and constructive language. The goal is not only to convey results, but also to foster partnerships between teachers, students, and parents in supporting continuous learning development [1, 6, 7]. Simply put, assessment is a core component that is inseparable from the educational process (teaching-learning-assessment), which influences the quality of learning and teaching and educational equality [69]. Thus, at the level of mastery of proficient teacher competencies, teachers must have the ability to evaluate and design improvements to student-centered assessment, feedback, and reporting through the latest research studies and best practices from colleagues on an ongoing basis to improve the quality of student-centered learning.

3-5-4- Significance of the Present Study's Findings

This study makes an important contribution to the development of a pedagogical competency framework for proficient teachers in Indonesia. These competencies encompass not only mastery of pedagogical theory and practice but also self-management, professionalism, and effective relationship management. Therefore, the PCAI-PT serves not only as an evaluation tool but also as a means of professional reflection for teachers to improve the quality of student-centered learning, ensuring that any incentives they receive at the functional level are commensurate with their performance levels. Conceptually, the PCAI-PT can serve as a basis for developing policies and teacher training

programs. For example, the government or educational institutions can use the PCAI-PT assessment results to design professional development programs that emphasize continuous evaluation, pedagogical innovation, and effective classroom management. Thus, this instrument not only assesses teacher competency but also encourages systematic improvement in the quality of learning.

By integrating the PCAI-PT findings with previous research, this instrument addresses a significant gap in the measurement of teacher pedagogical competency in Indonesia. The PCAI-PT is capable of assessing pedagogical competence holistically, including aspects of evaluation and continuous improvement, which are the core competencies of proficient teachers according to the Regulation of the Directorate General of Teachers and Education Personnel Number: 2626/B/HK.04.01/2023 concerning the Teacher Competency Model [1]. With proven validity and reliability, this instrument has the potential to become a national standard tool in assessing teacher pedagogical competence, as well as being a basis for continuous teacher professional development. Overall, this study shows significant progress in measuring teacher pedagogical competence in Indonesia. This instrument (PCAI-PT) not only complements some of the shortcomings of previous instruments but also offers a more holistic and representative approach. In the future, the PCAI-PT can be used to build a more effective, evidence-based teacher evaluation system, and is oriented towards continuously improving the quality of student-centered learning according to the needs and challenges of the 21st century, while supporting the achievement of national proficient teacher competency standards.

4- Conclusion

This study concludes that the Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT) has been proven to have a high level of validity and reliability as a measuring tool for teacher pedagogical competence. Based on the validation results by six experts, all 13 items were declared valid after the revision process, with Aiken-V values between 0.78 and 1.00, indicating a very strong level of agreement. Intraclass correlation analysis indicated increased consistency between raters, so this instrument has good inter-rater reliability. Construct testing using CB-SEM resulted in loading factor values >0.70, Cronbach's alpha and composite reliability >0.70, and AVE >0.50, confirming that each item accurately represents the latent variable. In addition, discriminant validity and goodness-of-fit tests of the model showed well to excellent data fit, indicating the stability of the measurement model. Concurrent validity testing using Kruskal-Wallis also demonstrated no significant differences based on educational level ($p>0.05$), indicating that the PCAI-PT can be used consistently across various educational contexts. Thus, the PCAI-PT has proven effective, accurate, and representative as a measurement instrument for the pedagogical competence of professional teachers in Indonesia.

The results of this study have significant practical implications for educational institutions, the government, and stakeholders in the field of teacher professional development. First, the PCAI-PT can be used as a standard instrument in the assessment, mapping, and monitoring of the pedagogical competence of proficient teachers. This instrument enables objective, transparent, and evidence-based evaluations, so that the results can serve as a strong basis for determining teacher promotions, demotions, and functional career development. Second, assessment results using the PCAI-PT can assist educational institutions in designing more targeted teacher training and professional development programs that meet real-world needs. Third, the periodic implementation of the PCAI-PT can support internal quality assurance systems, particularly in improving the quality of learning and the effectiveness of the educational process. Furthermore, the use of a valid and reliable instrument such as the PCAI-PT will strengthen the accountability of education policies and ensure that teacher competency development aligns with curriculum demands and the transformation of national education toward sustainable quality.

Although the PCAI-PT shows promising results, several points need to be considered for further development. First, empirical testing of this instrument is still limited to a specific sample; therefore, replication is necessary in a broader context, including schools with diverse student characteristics and curricula. Second, the integration of technology and pedagogy 4.0 aspects could be expanded to make the instrument more relevant to the demands of 21st-century learning. Third, the development of additional indicators measuring teachers' abilities in professional collaboration, curriculum innovation, and inclusive learning management could increase the instrument's comprehensiveness.

5- Declarations

5-1- Author Contributions

Conceptualization, J.B., A.J.F.L., B., and I.C.A.S.; methodology, J.B. and B.; software, J.B., A.T.S., and V.Y.; validation, J.B., A.J.F.L., and B.; formal analysis, J.B., H., and A.T.S.; investigation, J.B., A.J.F.L., and B.; resources, J.B., I.C.A.S., H., A.T.S., and H.; data curation, J.B., I.C.A.S., H., and V.Y.; writing—original draft preparation, J.B.; writing—review and editing, J.B., A.J.F.L., and B.; visualization, J.B., I.C.A.S., H., A.T.S., and H.; supervision, J.B., A.J.F.L., and B.; project administration, J.B. and I.C.A.S.; funding acquisition, H., A.T.S., H., and V.Y. All authors have read and agreed to the published version of the manuscript.

5-2- Data Availability Statement

The data presented in this study are available on request from the corresponding author.

5-3- Funding

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5-5- Institutional Review Board Statement

Not applicable.

5-6- Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

5-7- Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

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Appendix I: Pedagogical Competence Assessment Instrument for Proficient Teachers

A. Description

The Pedagogical Competence Assessment Instrument for Proficient Teachers (PCAI-PT) was designed to assess teacher competency at the proficient teacher level, namely teachers who consistently demonstrate pedagogical performance in creating a safe, enjoyable, and student-centered learning environment, effective student-centered learning, and student-centered assessment, feedback, and reporting.

This assessment has two main objectives. First, it records teachers' current competencies to help schools, principals, supervisors, and teachers themselves obtain a factual picture of how far teachers' competencies have developed in creating a safe and comfortable learning environment, implementing effective, student-centered learning, and implementing student-centered assessment, feedback, and reporting. Second, the assessment results are used as a basis for developing a continuous competency development plan. Teachers can reflect on their strengths and areas for improvement, while schools can design training and mentoring programs tailored to the actual needs of teachers in the field.

Thus, PCAI-PT is not only an evaluation tool, but also a diagnostic and professional development instrument that supports improving the quality of learning and student learning well-being so that teachers must provide responses with integrity.

B. Instructions

Respondents read each statement carefully and rate how often the described behavior or practice is carried out in daily learning activities. The assessment uses a seven-level Likert scale, with the following ranges: 1 = Never; 2 = Very rarely; 3 = Rarely; 4 = Sometimes; 5 = Often; 6 = Very often; and 7 = Always.

C. Instrument

No.	Item	Response
1	I regularly evaluate learning models to address barriers to students' analytical thinking. (*Saya secara teratur mengevaluasi model pembelajaran untuk mengatasi hambatan berpikir analitis peserta didik*).	1 2 3 4 5 6 7
2	I design differentiated learning that encourages students to explore their potential according to their learning styles. (*Saya merancang pembelajaran berdiferensiasi yang mendorong peserta didik mengeksplorasi potensinya sesuai gaya belajar mereka*).	1 2 3 4 5 6 7
3	I evaluate learning approaches to minimize potential physical and non-physical hazards in the learning environment. (*Saya mengevaluasi pendekatan pembelajaran agar dapat meminimalisir potensi bahaya fisik dan non-fisik di sekitar lingkungan belajar*).	1 2 3 4 5 6 7
4	I regularly evaluate the sequence of learning designs to support learning objectives in accordance with the latest curriculum. (*Saya secara rutin mengevaluasi urutan desain pembelajaran untuk mendukung tujuan pembelajaran sesuai dengan kurikulum terbaru*).	1 2 3 4 5 6 7
5	I actively collaborate with students when designing learning. (*Saya berkolaborasi aktif bersama peserta didik saat mendesain pembelajaran*).	1 2 3 4 5 6 7
6	I evaluate learning resources used to ensure the effectiveness of achieving learning objectives. (*Saya mengevaluasi sumber belajar yang digunakan untuk memastikan efektivitas pencapaian tujuan pembelajaran*).	1 2 3 4 5 6 7
7	I evaluate communication strategies to enhance students' critical thinking. (*Saya mengevaluasi strategi komunikasi untuk meningkatkan pemikiran kritis peserta didik).*	1 2 3 4 5 6 7
8	I evaluate the use of adaptive technology to improve the quality of learning. (*Saya mengevaluasi pemanfaatan teknologi yang adaptif untuk meningkatkan kualitas pembelajaran*).	1 2 3 4 5 6 7
9	I design assessments that allow students to choose the format of final assignments according to their interests. (*Saya merancang asesmen yang mengizinkan siswa memilih bentuk tugas akhir sesuai dengan minat mereka*).	1 2 3 4 5 6 7
10	I evaluate the use of peer assessments to enhance students' critical thinking in formative assessments. (*Saya mengevaluasi penggunaan asesmen sejawat untuk meningkatkan pemikiran kritis siswa dalam assessmen formatif*).	1 2 3 4 5 6 7
11	I evaluate the effectiveness of feedback on improving student learning outcomes. (*Saya mengevaluasi efektivitas umpan balik terhadap peningkatan hasil belajar peserta didik*).	1 2 3 4 5 6 7
12	I create learning achievement reports based on student progress. (*Laporan capaian belajar yang saya buat sesuai dengan perkembangan peserta didik*).	1 2 3 4 5 6 7
13	I convey learning achievement reports transparently to students and parents. (*Saya menyampaikan laporan capaian belajar secara transparan kepada peserta didik dan orang tua*).	1 2 3 4 5 6 7

Note: First, indicators of a safe and comfortable learning environment for students (items 1-3). Second, indicators of effective, student-centered learning (items 4-8). Third, indicators of student-centered assessment, feedback, and reporting (items 9-13)

D. Scoring and Interpretation

Each item is scored on a scale from 1 to 7 according to the respondent's answer. The total score is obtained by summing all 13 items, resulting in a score range of 13-91. Next, the width of each category is calculated by subtracting the minimum score from the maximum score (91-13 = 78) and dividing the result by 5, yielding a pedagogical competence score range of 15.6 per category for proficient teachers.

Range score	Competency category	General description of competencies
13.0-28.6	Very poor	Teachers have not demonstrated professional practices; the learning environment is not safe or student-centered.
28.7-44.2	Poor	Teachers sometimes apply the principles of effective learning, but this is not consistent and has not had a significant impact on students.
44.3- 59.8	Moderate	Teachers are starting to implement student-centered strategies, but still need to strengthen consistency and self-reflection.
59.9-75.4	Good	Teachers demonstrate fairly consistent practices in creating a safe environment, effective learning, and learner-oriented assessment.
75.5.91.0	Very good	Teachers consistently implement superior pedagogical practices; student-centered learning is reflective, creative, and impactful.