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Construction of Analytical Thinking Skills Instruments for Micro Teaching Courses

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ABSTRAK

Menjalani kehidupan abad 21, salah satu hal penting yang menjadi perhatian dunia pendidikan adalah pengembangan kegiatan kemampuan berpikir analitis siswa. Penelitian di berbagai negara hanya menemukan sedikit penelitian tentang pengembangan instrumen berpikir analitis untuk mata kuliah Micro Teaching. Laporan beberapa penelitian terbatas pada pengembangan instrumen berpikir analitis untuk siswa sekolah dasar. Penelitian ini bertujuan untuk mengonstruksi instrumen keterampilan berpikir analitis untuk perkuliahan Micro Teaching dengan mengadopsi model penelitian pengembangan (desain tes, uji coba tes, dan perakitan tes). Sembilan item didesain menggunakan konsep keterampilan berpikir analitis dari Anderson dan rekan–rekannya, yakni mendiferensiasi, mengorganisasi, dan mengatribusi lalu divalidasi oleh 9 orang rater dan diijocobakan kepada 30 orang mahasiswa. Pengujian validitas konten (penilaian rater) menggunakan formula Aiken–V, pengujian relibilitas menggunakan formula alpha Cronbach, pengujian Inter–Rater Reliability dari Pearson's Intraclass Correlation Coefficients, pengujian validitas konstruk menggunakan Exploratory Factor Analysis (EFA), serta menganalisis kesukaran dan daya beda item. Hasil penelitian membuktikan bahwa validitas konten setiap butir soal danuji reliabilitas telah terpenuhi. Sedangkan hasil uji coba menggunakan EFA terkonfirmasi tebentuk tiga faktor dominan dengan nilai loading faktor >0.50, dengan koefisien reliabilitas uji coba sebesar 0.82. Instrumen layak digunakan karena selain memenuhi parameter pengujian statistik, instrumen ini juga lebih operasional, kontekstual, dan praktis digunakan untuk mengukur dan menilai keterampilan berpikir analitis untuk perkuliahan Micro Teaching.

ABSTRACT

Living the life of the 21st century, one of the essential things that the world of education pays attention to is the development of students' analytical thinking skill activities. Research in various countries found only a few studies on developing analytical thinking instruments for Micro Teaching courses. Reports of several studies are limited to developing analytical thinking instruments for elementary school students. This research aims to construct analytical thinking skill instruments for Micro Teaching courses by adopting a development research model (test design, test trials, and test assembly). Nine items were designed using the concept of analytical thinking skills from Anderson and his colleagues; differentiation, organizing, and attributing, then validated by nine raters and tested on 30 students. Content validity testing (rater assessment) uses the Aiken–V formula, reliability testing uses Cronbach's alpha formula, Inter–Rater Reliability testing from Pearson's Intraclass Correlation Coefficients, construct validity testing uses Exploratory Factor Analysis (EFA), as well as analyzing the difficulty and discrimination item. The research results prove that the validity of the content of each item and the reliability test has been fulfilled. While the results of the trial using EFA confirmed the formation of three dominant factors with a loading factor value of >0.50, with a reliability coefficient of 0.82. The instrument is appropriate to use because, in addition to fulfilling the parameters of statistical testing, this instrument is also more operational, contextual, and practical to use to measure and assess analytical thinking skills for Micro Teaching courses.

1. INTRODUCTION

Research in various countries found only a few studies on developing analytical thinking instruments for Micro Teaching courses. Reports of several studies are limited to developing analytical thinking instruments for elementary school students and high school (Blegur, Rajagukguk, et al., 2023; Kesorn et al., 2020; Thaneerananon et al., 2016). Meanwhile, the most recent validation of analytical thinking skill instruments for university students is found in the studies of previous studies (Aksu, G., &

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Aser, 2020; Areesophonpichet, 2013; Baysal, E. A., & Ocak, 2022). According to, students must have analytical thinking skills to complete research and develop new knowledge and innovations. Given that analytical thinking skills are important for the development of student competence students (Jumhur et al., 2021; Sari, W. K., & Nada, 2022; Supriati, Y. et al., 2021), the need for instruments by adopting "global" ideas and being reduced according to "local" contexts and courses is needed to operationalize learning activities according to problem–solving as well as being a valid and valid parameter in measuring analytical thinking student (Ad'hiya, E., & Laksono, 2020; Wiyarsi et al., 2019; Yandriani & Erna, 2020).

Analytical thinking plays an important role in every individual's future decisions, so previously grouped analytical thinking skills as the Higher–Order Thinking Skills (HOTS) group (Buch et al., 2021). It has made researchers in various countries examine analytical thinking skills from elementary and secondary schools to universities. For example, they investigated the correlation of critical thinking with analytical thinking skills in secondary schools in Indonesia (Mayarni & Nopiyanti, 2021), analytical thinking styles in mathematics learning in Chile (Huincahue et al., 2021), critical thinking dispositions and analytical thinking skills in Turkey (Demir, 2022), as well as developing analytical thinking using problem–based learning and think–pair–share techniques (Theabthueng, 2022). Universities are also included. Researchers develop various learning practices to develop students' analytical thinking. For example, in Turkey, using case–based science scenarios (Kirman-Bilgin & Kala, 2022); in Thailand, implementing learning management plans (Sitthipon, 2017), using information search activities (Puchumni, Tungpradabkul, & Magee, 2019), using research–based learning (RBL) (Chumsukon & Ruangsan, 2021), and digital storytelling and inquiry–based learning (IBL) (Phurikultong & Kantathanawat, 2022), in Ukraine and using debate (Spaska et al., 2021), and in Indonesia applying research–based learning (RBL) (Ahdika, 2017).

In line with increasing interest in studying analytical thinking in universities, the Micro Teaching course tries to do the same thing, but there is a different emphasis. For example, how analytical thinking skills are intended to improve teaching skills, improve academic integrity, improve transformational leadership, and increase analytical thinking itself. Analytical thinking skills are one of the main competencies expected of a learning process in higher education, so lecturers need to familiarize their students with the experience of gathering information, considering problems, classifying, expanding estimates, finding relationships, and drawing conclusions (Ahdika, 2017; Kwangmuang et al., 2021; Sitthipon, 2012). Suppose we operationalize it into Micro Teaching lectures. In that case, lecturers must familiarize and train students to distinguish learning success from individuals with high and low teaching skills, organize indicators of easy and difficult teaching skills for successful learning, attribute various solutions and make decisions to improve teaching skills. This example confirms that the development of analytical thinking skills does not occur naturally. However, there is an activity engineering intervention that promotes analytical reasoning through a series of factual and actual student learning experiences.

Living the life of the 21st century, one of the essential things that the world of education pays attention to is the development of students' analytical thinking skill activities (Mayarni, M., & Nopiyanti, 2021; Putri et al., 2019; Suyatman et al., 2021). *Analytical thinking* is an ability that helps individuals understand and assess material by associating and classifying useful or useless information and evaluating the reliability of information to make problem–solving decisions (Plöger et al., 2020; Ramadani et al., 2021; Sitthipon, 2012). Analytical thinkers are good problem–solvers, mature decision–makers, and active and productive learners. They can understand information or concepts in depth and detail and link any information or ideas (Ramadani et al., 2021; Rengganis, A. P., & Yulianto, 2018). It is noted that individuals who prioritize analytical thinking can provide the right solutions through analytical processes and problem–solving processes, so that they can develop their abilities on an ongoing basis (Mahyastuti et al., 2020; Putri et al., 2019). They do not issue many incentives while studying or working to achieve their goals. They ensure that every decision and action carried out is effective and efficient because it refers to the work indicators that have been set.

Based on the previous literature review, this research is the only one that aims to construct analytical thinking skill instruments for prospective physical education (PE) teachers in Micro Teaching courses. As a result, during Micro–Learning, in addition to improving the teaching skills of prospective teachers, lecturers can also evaluate students' analytical thinking based on transformational leadership, the use of information technology, and academic integrity using valid and reliable instruments. The aims of this study is to to construct analytical thinking skill instruments for Micro Teaching courses by adopting a development research model (test design, test trials, and test assembly).

2. METHODS

This study usedthe research and development design (Oriondo, L. L., & Dallo–Antonio, 1984). They offered three important stages: test design, test run, and test assembly. First, the test design includes 1)

determining the purpose of the test, in which this instrument is used as a medium to measure analytical thinking skills both formatively and summatively. 2) determining the competencies to be tested, in which the development of this instrument is to measure students' analytical thinking competencies/skills. 3) determining the material to be tested, namely the material for teaching student skills for Micro Teaching lectures. 4) preparation of test grids, including differentiating, organizing, and attributing. Each indicator consists of 3 questions as show in Table 1. 5) the writing of the test items was developed into nine essay items, each representing three indicators of analytical thinking ability from. The nine items were assessed using a scoring rubric on a 4–point scale. 6) validation of test items was carried out to ensure that the items have met the high predictive elements. Nine raters were involved in item development. Each expert and practitioner has experience in HOTS and Micro Teaching education and research (see Table 2), with an average teaching experience of ±12 years. Testing content validity using the Aiken–V formula, the item isvalid if it has an efficiency equal to or exceeds the value of 0.72 (9 raters with 5 rating categories). 7) repairing of test items and test assembly was carried out following the results of the assessment and rater recommendations. The repair results were reassembled to become valid items (content) to be tested on students. 8) preparation of scoring guidelines needed to reduce bias in assessing student work using a four–graded scale (Blegur, Rajagukguk, et al., 2023).

Table 1. Indicator and Item (Essay) for Analytical Thinking Skill

Indicators	Definition	Item (Questions)
Differentiating	Distinguish the relevant or essential part from the irrelevant or unimportant part of the material presented	1 Why do you need to master teaching skills? 2 What is your strategy for improving teaching skills during class? 3 What is your attitude if there are teaching skills that do not improve after class?
Organizing	Determine how elements fit or function within a structure	4 Why are analytical thinking skills an important element of teaching skills? 5 Why are transformational leadership skills an important element of teaching skills? 6 Why is mastery of information technology an important element of teaching skills?
Attributing	Determine the point of view, bias, value, or intent that underlies the material presented	7 Why is an assessment instrument needed to improve your teaching skills? 8 Why do you need a colleague of integrity to evaluate teaching skills? 9 How does your strategy reflect peer input for improving teaching skills?

Second, the try–out test included 1) determining the subject of the trial, namely students who have passed the Micro Teaching course program or have passed the "Teaching Campus" program from the Ministry of Education and Culture of the Republic of Indonesia they are students of the Physical, Health, and Recreation Education Study Program, Faculty of Teacher Training and Education, Universitas Kristen Artha Wacana so they can have various learning experiences that reflect improvement and enhancement of analytical thinking skills in Micro Teaching lectures. There were 30 test subjects (male = 20, female = 10) determined using a purposive sampling technique. 2) Implementation of the trial test was carried out from 16 November to 13 December 2022, using nine items that have been validated (revised version). Items were circulated using a Google form to avoid researcher intervention on trial subjects. 3) trial data results were analyzed after all trial data has been collected. Aspects of analysis included item validity (content and construct), reliability item (content and construct), item difficulty level, and item discrimination. The descriptive analysis calculated the rater's summary, mean, and standard deviation (content validity).

Content validity was also tested using the Aiken–V formula and Inter–Rater Reliability from Pearson's Intraclass Correlation Coefficients using norms from with 95% confidence intervals, namely: 1) <0.50 (poor), 2) 0.50–0.75 (moderate), 3) 0.75–0.90 (good), and 4) >0.90 (excellent) (Aiken, 1985; Koo, T. K., & Li, 2016). The N–Gain formula was used to assess changes or increases in the rater's assessment of the original and revised questions. Further, the test constructs validity using Exploratory Factor Analysis (EFA). Test the reliability of the test items using the Cronbach alpha formula and norms from, namely: 1) <0.60 (poor), 2) 0.60 to <0.70 (acceptable for exploratory research), 3) 0.70 to<0.80 (good), 4) 0.80 to<0.90 (excellent), 5) 0.90 to 0.95 (somewhat high), and 6) ≥ 0.95 (too high; indicators are redundant). While the item difficulty level test adopted the formula and the norm (Sharma, 2021; Thorndike, R. L., & Hagen, 1977),

where: 1) 0–0.30 (difficult), 2) 0.30–0.70 (moderate), and 3) 0.70–1.0 (easy). The item differentiating power test used the formula and norm, where: 1) 0.00–0.20 (poor), 2) 0.21–0.40 (moderate), 3) 0.40–0.70 (good), and 4) 0.70–1.00 (excellent) (Sharma, 2021; Sudijono, 2011). The entire testing process used the help of Microsoft Excel and the SPSS application version 24. Rater for item development is show in Table 2.

Table 2. Rater for Item Development

Rater	Gender	Age	Teaching Experience (Years)	Affiliation
1	Male	63	38	Universitas Nusa Cendana
2	Male	34	12	Universitas Sriwijaya
3	Female	33	9	STKIP PGRI Jombang
4	Female	61	12	Sekolah Tinggi Teologi Injili Indonesia
5	Male	35	8	Universitas Pendidikan Ganesha
6	Male	34	11	Universitas Siliwangi
7	Female	35	4	STKIP Al Amin Dompu
8	Female	33	7	Universitas Muhammadiyah Kalimantan Timur
9	Female	33	7	Universitas Ahmad Dahlan

Finally, the assembly test is to revise the test results if they do not meet the degree of validity and reliability of the items so that they are ready to be used by students and lecturers in Micro Teaching courses. Unlike the revision at the test design stage, this stage is a post–trial revision process. If an item does not meet the four aspects of analysis (validity and others), the questions are reassembled and tested on students until they meet high credibility criteria. Meanwhile, if the item meets the parameters, it can be used as an instrument.

3. RESULT AND DISCUSSION

Results

The presentation of research results follows the research and development structure. So that it will start from the test design step, trial test, and end with assembly test.

Test design

Construction of items apart from measuring analytical thinking skills is contextualized into Micro Teaching lectures. It means that the nine items that are designed "borrow" teaching skills material to improve students' analytical thinking. The goal is for students to maximize their thinking skills to update their teaching skills during Micro Teaching lectures. The results of the item designs that have been rater validation are shown in Table 3.

Table 3. Result of Raters' Assessment on Items (Before and After Revision)

	Item 1		Item 2		Item 3		Item 4		Item 5		Item 6		Item 7		Item 8		Item 9	
	ov	rv	ov	rv	ov	rv	ov	rv	ov	rv	ov	rv	ov	rv	ov	rv	ov	rv
R–1	5	5	4	4	3	4	5	4	5	5	5	5	5	5	5	5	5	5
R–2	3	5	4	4	4	4	3	4	3	4	3	5	5	4	4	5	5	5
R–3	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5
R–4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
R–5	5	4	5	5	4	4	4	5	4	5	5	5	4	5	5	5	5	5
R–6	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5	4	5
R–7	4	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5
R–8	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5
R–9	3	4	3	4	3	4	4	5	4	5	4	5	4	4	5	5	5	5
∑	38	42	39	41	36	40	37	42	38	43	40	44	41	42	42	44	43	44
M	4.2	4.7	4.3	4.6	4.0	4.4	4.1	4.7	4.2	4.8	4.4	4.9	4.6	4.7	4.7	4.9	4.8	4.9
SD	0.8	0.5	0.7	0.5	0.7	0.5	0.7	0.5	0.6	0.4	0.7	0.3	0.5	0.5	0.5	0.3	0.4	0.3
N–G	**0.06**		**0.03**		**0.06**		**0.08**		**0.08**		**0.07**		**0.02**		**0.03**		**0.02**	

Description: ov (orginal version); rv (revised version); R = rater; N–G (N–Gain)

Base on Table 3, the results of the raters' validation indicated that the original version of the items has a breakdown of 11.1% for 3, 40.7% for 4, and 48.1% for 5 (M = 4.37±SD = 0.68). In the original version, all items met the Aiken coefficient because it was greater than or equal to the 0.72 thresholds. The lowest Aiken coefficient is on item 3 (0.72), and the highest is on item number 9 (0.94). Furthermore, the reliability value of the nine items is 0.84. The reliability value is classified as excellent when using the norm. In contrast, Pearson's Intraclass Correlation Coefficients test shows that the Inter–Rater Reliability value is 0.38, thus, it is classified as poor (≤0.50) based on the norm from.

Considering the rater's notes and recommendations, indeed, not all rater notes are accommodated exactly according to the editorial they offer. However, in substance, the rater's recommendations are synthesized and reduced to accommodate indicators of analytical thinking. Revised item after validation is show in Table 4.

Table 4. Revised Item After Validation from Rater

No.	Original Version	Revised Version
1	Why do you need to master teaching skills?	Why does a prospective educator need to master teaching skills in Micro Teaching lectures?
2	What is your strategy for improving teaching skills during class?	What are the suitable strategies to improve your teaching skills during Micro Teaching class?
3	What is your attitude if there are teaching skills that do not improve after class?	What actions are needed to overcome inefficient Micro Teaching lecture strategies to improve your teaching skills?
4	Why are analytical thinking skills an important element of teaching skills?	How do analytical thinking skills contribute to improving your teaching skills?
5	Why are transformational leadership skills an important element of teaching skills?	How has transformational leadership contributed to improving your teaching skills?
6	Why is mastery of information technology an important element of teaching skills?	How does the mastery of information technology contribute to improving your teaching skills?
7	Why is an assessment instrument needed to improve your teaching skills?	Why is an assessment instrument needed in evaluating the teaching skills you apply?
8	Why do you need a colleague of integrity to evaluate teaching skills?	Why do you need a colleague of integrity to evaluate teaching skills?
9	How does your strategy reflect peer input for improving teaching skills?	Once you've put your teaching skills into practice, how will your strategy reflect peer input as you improve your teaching skills?

After revising, the item is circulated (via email or WhatsApp) again to the rater for validation. Of the nine raters, only eight (88.9%) responded to the revised results, so one rater (11.1%) still used the original version of the assessment. The validation results show that the item with the lowest value of 4 is 28.4%, and the highest is 5 of 71.6% (4.71±0.45). Content validity proves that all items have high validity because they exceed the Aiken coefficient of 0.72 as show in Figure 1.

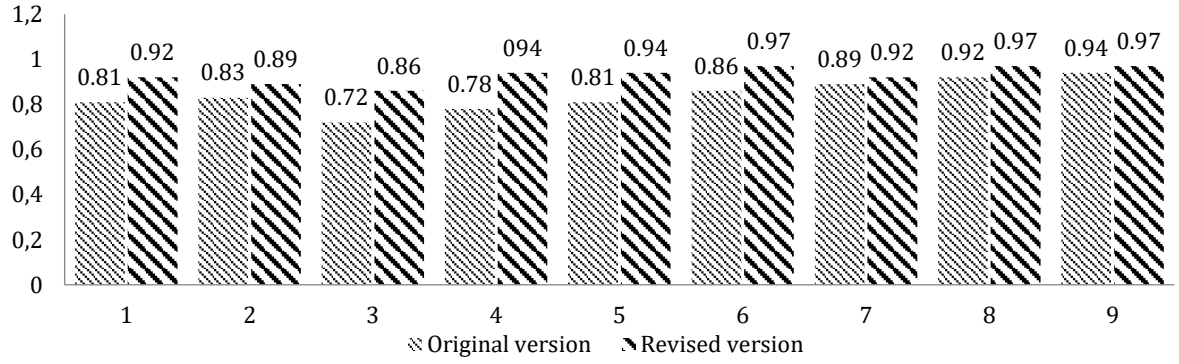

Figure 1. Aiken–V Analysis Result

Base on Figure 1, the lowest Aiken–V is in item 3 (0.86), and the highest is in items 6, 8, and 9 (0.97). All items also have a somewhat high Cronbach reliability coefficient based on the norm, which is 0.91.

Furthermore, Pearson's Intraclass Correlation Coefficients analysis found an Inter–Rater Reliability value of 0.53. If we use the criteria from, it is in the moderate category (0.50–0.75).

Assessing essay questions in any form takes much time, so care is needed to maintain the consistency of the assessment. Therefore, one strategy to maintain reliability in assessment and time efficiency is to provide an assessment rubric. Including differentiating (distinguishing relevant or important parts from irrelevant or unimportant parts of the material presented), organizing (determining how elements fit or function within a structure), and attributing (determining the point of view, bias, value, or intent that underlies the presented materials). The three indicators of analytical thinking skills are assessed on a 4–level scale (unable to able). Rubric for analytical thinking skill is show in Table 5.

Table 5. Rubric for Analytical Thinking Skill

Indicator	Answer Scale			
	4	3	2	1
Differentiating (questions 1–3)	Students are able to distinguish relevant or important parts from irrelevant or unimportant parts of the material presented	Students are quite able to distinguish relevant or important parts from irrelevant or unimportant parts of the material presented	Students are less able to distinguish relevant or important parts from irrelevant or unimportant parts of the material presented	Students are unable to distinguish relevant or important parts from irrelevant or unimportant parts of the material presented
Organizing (questions 4–6)	Students are able to determine how elements fit or function within a structure	Students are quite able to determine how elements fit or function in a structure	Students are less able to determine how elements fit or function in a structure	Students are unable to determine how elements fit or function in a structure
Attributing (questions 7–9)	Students are able to determine the point of view, bias, value, or intent that underlies the material presented	Students are quite able to determine the point of view, bias, value, or intent that underlies the material presented	Students are less able to determine the point of view, bias, value, or intent that underlies the material presented	Students are not able to determine the point of view, bias, value, or intent that underlies the material presented

Trial test

The results of the instrument development were tested on 30 students using EFA. EFA is one of a family of multivariate statistical methods that attempt to identify the smallest number of hypothetical constructs (also known as factors, dimensions, latent variables, synthetic variables, or internal attributes) that can sparingly explain the observed covariation between a set of measured variables. Exploratory factor analysis to identify common factors that explain the order and structure among the variables measured. Kaiser–Meyer–Olkin and bartlett's test result is show in Table 6.

Table 6. Kaiser–Meyer–Olkin and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.691
Bartlett's Test of Sphericity	Approx. Chi–Square	91.054
	df	36
	Sig.	0.000

Base on Table 6, the Kaiser–Meyer–Olkin (KMO) value in the factor test is 0.81. Referring to the KMO norm from, sampling based on the KMO test is classified as mediocrity (0.60–0.69). Meanwhile, the value of Bartlett's Test of Sphericity is 91.054 with a significance value of 0.000 (<0.05). As a result, the instrument is eligible to pass the EFA test. After receiving the KMO and Bartlett's Test of Sphericity values, the next test is to look for the Anti–image Correlation value. Measures of sampling adequacy are show in Table 7.

Table 7. Measures of Sampling Adequacy

		1	2	3	4	5	6	7	8	9
Anti-image Correlation	1	0.746[a]	-0.582	-0.051	0.133	-0.216	-0.015	-0.067	-0.199	-0.315
	2	-0.582	0.622[a]	-0.250	-0.090	0.036	-0.112	0.124	-0.216	0.385
	3	-0.051	-0.250	0.710[a]	-0.133	-0.090	0.146	-0.206	0.270	-0.363
	4	0.133	-0.090	-0.133	0.582[a]	-0.435	-0.493	0.369	-0.057	-0.185
	5	-0.216	0.036	-0.090	-0.435	0.725[a]	0.000	-0.422	0.103	0.183
	6	-0.015	-0.112	0.146	-0.493	0.000	0.768[a]	-0.208	-0.102	-0.090
	7	-0.067	0.124	-0.206	0.369	-0.422	-0.208	0.672[a]	-0.315	-0.229
	8	-0.199	-0.216	0.270	-0.057	0.103	-0.102	-0.315	0.766[a]	-0.090
	9	-0.315	0.385	-0.363	-0.185	0.183	-0.090	-0.229	-0.090	0.630[a]

Base on Table 7, the Anti–image Correlation value for nine items is 0.582–0.768, so there is no factor with a value less than 0.50. Thus, the question load value contributes to the instrument's factor structure. By referring to the results of the Anti–image Correlation test, the essay questions developed meet the requirements for conducting factor formation tests. Total Varian result is show in Table 8.

Table 8. Total Varian Explained

Comp.	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	3.772	41.912	41.912	3.772	41.912	41.912	2.164	24.047	24.047
2	1.205	13.385	55.297	1.205	13.385	55.297	2.074	23.043	47.091
3	1.175	13.057	68.354	1.175	13.057	68.354	1.914	21.264	68.354
4	0.893	9.925	78.279						
5	0.695	7.720	85.998						
6	0.427	4.748	90.746						
7	0.392	4.353	95.099						
8	0.237	2.631	97.730						
9	0.204	2.270	100.000						

Base on Table 8 explains that there are three factors formed from the nine items included (>1.000). Factor 1 was able to explain 41.912% of the total variance, factor 2 was able to explain 13.385% of the total variance, and factor 3 was able to explain 13.057% of the total variance. Thus, the three factors are able to explain 68.354% of the total variance, so other factors explain 31.646%. Factors 4–9 are not presented with their ability to explain variance because the initial total eigenvalue is not more than 1 (0.204–0.893).

Scree plot visualization finds a reduction in eigenvalue measures with factors/components. According to, when the eigenvalue drops dramatically, the factor will add relatively little information that has been extracted as show in Figure 2.

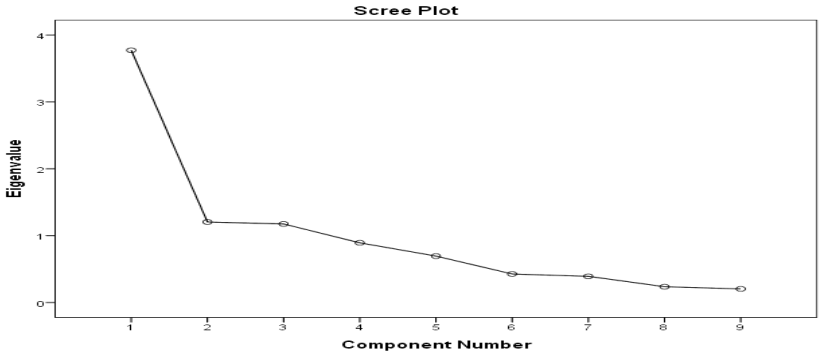

Figure 2. Scree Plot Curve

Base on Figure 2 explains that the scree plot graph finds three reduced factors with an eigenvalue greater than 1. The remaining six other factors are not reduced because they have a value of less than 1. Extraction value and rotated component matrix is show in Table 9.

Table 9. Extraction Value and Rotated Component Matrix

	Extraction Value	Component/Factor		
		1	2	3
1	0.771	0.774		
2	0.738	0.820		
8	0.618	0.763		
3	0.564		0.715	
7	0.669		0.723	
9	0.699		0.820	
4	0.860			0.922
5	0.566			0.576
6	0.666			0.748

The output extraction value in Table 9 explains that all items/variables can explain the factors because they have a value >0.50. Furthermore, the varimax rotation method results found a correlation value between variables and factors (factor loading) greater than 0.50. Thus, the construction of the instrument met the good validity parameters. In addition, Table 9 explains that items 1, 2, and 8 are included in factor 1. Items 3, 7, and 9 are included in factor 2. Items 4, 5, and 6 are included in factor 3. Table 10 show component transformation matrix.

Table 10. Component Transformation Matrix

Component	1	2	3
1	0.613	0.583	0.533
2	-0.662	0.747	-0.056
3	-0.431	-0.319	0.844

Table 10, show the component transformation matrix explains that on the correlation value of component 1, 0.613>0.50, component 2, 0.747>0.50, and component 3, 0.844>0.50. It means that the three factors formed appropriately summarise the nine items constructed.

In addition to testing construct validity, we also carry out reliability testing. The total internal reliability coefficient of Cronbach's alpha from the results of the item trials obtained a value of 0.82, so it is interpreted that there is a certainty of 81.9% of the consistency of the item in displaying the same results repeatedly. The reliability coefficient is classified as excellent (0.80 to <0.90) according to the norms of. Item reliability shows that 55.6% of items have excellent reliability coefficients, and the remaining 44.4% are classified as good (see Table 11). Thus, the items developed are reliable for measuring students' analytical thinking skills for Micro Teaching lectures in the trial phase.

The next test is to find the item difficulty index. According to, the difficulty index for each item was carried out to get an idea of the proportion of test takers who answered the questions correctly. The item difficulty index test uses the formula and the norms from, proving that there are two items (22.2%) which are in the easy category (items 1, 7), there are seven items (77.8%) which are in the moderate category (items 2, 3, 4, 5, 6, 8, 9), and no items were categorized into the difficult category (0%).

The last is the analysis of discrimination items. Through discriminating power analysis, the ability of an item can be classified to distinguish between participants with high abilities and participants with low abilities. We can diagnose that items effectively evaluate students' analytical thinking skills in Micro Teaching courses. The results of the test for disrimination items refer to the formula and norm so that there are no items in the poor and moderate category (0%), the discrimination items in the good category is 77.8% (item 2, 3, 4, 6, 7, 8, 9), and in the excellent category of 22.2% (questions 1, 5). Coefficient of reliability, difficulty, and discrimination item is show in Table 11.

Table 11. Coefficient of Reliability, Difficulty, and Discrimination Item

Item	Reliability Item		Difficulty Item		Discrimination Item	
	Coefficient	Category	Coefficient	Category	Coefficient	Category
1	0.786	Good	0.750	Easy	0.753	Excellent
2	0.808	Excellent	0.675	Moderate	0.609	Good
3	0.806	Excellent	0.617	Moderate	0.594	Good
4	0.808	Excellent	0.558	Moderate	0.597	Good
5	0.791	Good	0.567	Moderate	0.706	Excellent

Item	Reliability Item		Difficulty Item		Discrimination Item	
	Coefficient	Category	Coefficient	Category	Coefficient	Category
6	0.796	Good	0.592	Moderate	0.686	Good
7	0.799	Good	0.742	Easy	0.674	Good
8	0.805	Excellent	0.592	Moderate	0.590	Good
9	0.808	Excellent	0.617	Moderate	0.584	Good

Assesmbly test

The study's results confirmed that the item met the requirements of the Aiken–V test, reliability test, Inter–Rater Reliability test, EFA validity test, item difficulty test and discrimination item. Thus, the items are ready to be assembled to become a credible instrument model to measure the analytical thinking skills of university students for Micro Teaching lectures. Determining the categorization of analytical thinking skills used the interval distance formula from. Referring to the assessment rubric with four graded scales with nine items, and adopting 3 class intervals, the criteria for determining the analytical thinking skills of university students for Micro Teaching courses are as follows: 1) 9–18 (poor), 2) 19–27 (moderate), 3) 28–36 (good).

Discussion

The results of this study succeeded in developing nine essay tests (instruments) to measure students' analytical thinking because they met the criteria for testing validity, reliability, difficulty, and discrimination items.This instrument is the only one that was successfully developed to measure the analytical thinking skills of prospective PE teachers. Given the high practical activity in Micro Teaching lectures, the instrument's construction needs to focus on the practicality of its application, such as adopting essay questions but focusing on indicators of analytical thinking processes (Shrestha, 2021; Watkins, 2018). According to previous study essay questions effectively determine how well individuals analyze, synthesize, evaluate, think logically, solve problems, and build hypotheses (Ornstein, 1992; Sadhu, S., & Laksono, 2018; Woods, C. M., & Edwards, 2011). Furthermore, complement that the advantages of essay questions are being able to assess higher–order thinking skills, evaluate thinking and reasoning and provide authentic experiences. In addition to its advantages, the problem often encountered when constructing essay questions is the weakness of item writing (Khan & Aljarallah, 2011; Reiner et al., 2002). Therefore, with the Aiken coefficient, we revise the items according to the rater's input and recommendations to meet a high degree of validity and reliability.

Apart from accommodating teaching skills, the items also consider analytical thinking and integrate it with transformational leadership, use of information technology, and empower prospective teachers' academic integrity. Indeed, the proportion is disproportionate to the teaching skill aspect, however, this aspect is important to stimulate the process of analyzing prospective teachers about the three attributes in items 5, 6, and 8. For example, by prioritizing collaborative efforts in groups, prospective teachers need each other's supportive peer input and inspiration. Meanwhile, academic integrity is related to colleagues' credibility when assessing teaching skills according to the rubric (Blegur, Rajagukguk, et al., 2023; Sharma, 2021; Thorndike, R. L., & Hagen, 1977). Through analytical thinking, prospective teachers can identify and rationalize the importance of determining transformational leadership, empowering and developing information technology, and academic integrity in supporting and improving their teaching skills. Also promotes a transformative work culture and integrity when they become professional teachers later in school.

Several analytical thinking instruments have been used in various studies of university students. First, uses eight tests to assess students' analytical thinking skills with three indicators, analysis of elements, analysis of relationships, and; organizational analysis (Areesophonpichet, 2013; Baysal, E. A., & Ocak, 2022). Second, used an essay test to assess analytical thinking skills using five indicators, including the dismemberment of the whole into its parts problems, the establishment of relationships between the parts of the whole issues, integration by parts problems, solution planning problems, and error finding issues with an explanation of the error reason (Kriswandani et al., 2019; Suyatman et al., 2021). Third, reduced the combination of indicators of analytical thinking skills and construct eight essay questions, including matching, classifying, organizing, and attributing. Finally, five indicators by to develop analytical thinking instruments, matching, classifying, analyzing errors, generalizing, and specifying (Asmar & Delyana, 2020; Yulina et al., 2021). Nonetheless, these studies did not specifically address instrument development analytical thinking skills, so information about the method testing the validity and reliability of the questions are not identified details.

Other research that specifically addresses the development of analytical thinking instruments is still limited to elementary school students (Blegur, Rajagukguk, et al., 2023; Kesorn et al., 2020;

Thaneerananon et al., 2016) and high school students (Wiyarsi et al., 2019; Ad'hiya & Laksono, 2020; (Yandriani & Erna, 2020). It is only verified that the research that has succeeded in developing analytical thinking skills instruments using a sample of university students. For example, previous study was limited to developing analytical thinking instruments by successfully instructing two dominant factors with a percentage of variance explained by factors of 43% (Aksu, G., & Aser, 2020). While in the study of it succeeded in constructing five factors of the cognitive bias scale in the context of analytical thinking with a percentage of variance explained by factors of 51.818% (Baysal, E. A., & Ocak, 2022). The Baysal and Ocak scales involve 25 items using the "Cognitive Bias" concept.

Different from that those research, the development of instruments in this study uses the concept of analytical thinking. The development details the indicators of differentiating, orsganizing, and attributing with nine essay questions (total variance of 68.354%). Another difference from previous research is that this study uses essay questions with honest answers so that students have more opportunities to explore and describe their factual and actual experiences about the process of thinking during the learning process (Jumhur et al., 2021; Sari, W. K., & Nada, 2022; Supriati, Y. et al., 2021). Therefore, this study was designed for micromaterialsteaching (teaching skills) in whichpioneeringstudent analysis skills about the importance of analytical thinking skills in improving theirteaching skills, pioneering student analysis of transformational leadership as an important element of their teaching skills, pioneering student analysis ofmastery of information technology as an important element of their teaching skills, pioneering student analysis of the determination of assessment instruments in improving their teaching skills, as well as spearheading student analysis of peer evaluation with integrity to improve their teaching skills (Karim, S. A., Sudiro, S., & Sakinah, 2021; Sharma, 2021; Sudijono, 2011).

In universities, teaching faculties are responsible for preparing professional teachers, so they must consider the range of teacher skills students need in schools. Education requires teachers who can provide quality education to students with diverse learning needs (Kim et al., 2017; Şchiopu, 2018). So what is the relevance of constructing transformational leadership items for prospective PE teachers? Transformational leadership positively impacts students' value expectations and intrinsic motivation. Students feel a climate that involves the task, they are excited harmoniously, and when they self–determine and show moderate to large effects on various individual, team, and organizational outcomes. As a result, organizations (including classroom learning) may benefit from focusing their resources on developing transformational leadership rather than the latest leadership trends (Castillo et al., 2020; Deng et al., 2022).

Several studies have confirmed that PE teachers are still experiencing problems in utilizing information technology (Friskawati et al., 2019; Irwahand et al., 2022). Therefore, the latest study by recommended that teachers improve the quality of learning by integrating information technology (Blegur, Lumba, et al., 2023). The recent rapid developments in information technology should be used as momentum and a stimulant to make teaching skills more effective and efficient. The use of conventional learning resources and media must be transformed into modern ones to facilitate the search and processing of information to improve the quality of learning, and teaching skills must be familiarized in universities (for example, in Micro Teaching lectures). For example, *"How does mastery of information technology contribute to improving your teaching skills?" The item* helps prospective teachers analyze (organize) their mastery of information technology as an element that contributes to improving their teaching skills. It even becomes a new habit in renewing their competencies as prospective professional teachers.

The final note, this instrument's construction is designed to promote the analytical thinking of prospective teachers by trying to analyze the determination of improving teaching skills using transformational leadership, integration of information technology, and cultivating academic integrity. This instrument is more practical because it only constructs nine items so that lecturers can measure their students' analytical thinking in the initial, midterm, and final tests to see their progress during Micro Teaching practice. Despite the practical number of items, methodologically, this instrument is reliable because it has good validity and reliability values. The credibility and practicality of this instrument can make it easier for lecturers to improve their evaluation activities on students' analytical thinking skills and design various strategic actions to solve problems and improve students' analytical thinking processes during Micro Teaching lectures.

Future investigations may consider the development of lesson plans and learning models oriented towards higher–level learning activities, including analytical thinking. Even though this instrument is available, ensuring the success of learning requires the integrity of the learning design and the development of learning models for the assessment and evaluation of learning. The results of this study have provided instruments that become important parameters to synergize with the quality of planning and the accuracy of selecting learning models in Micro Teaching lectures. Because if lecturers measure and assess the analytical thinking of university students without integrating it into lesson plans and learning models based

on analytical thinking, then the assessment process becomes unfair (overlaps) because "measuring something that is not ready to be measured".

4. CONCLUSION

The results of this study contribute to the development of science in instrumentation, so that lecturers can adopt it as an alternative when measuring the analytical thinking skills of university students in Micro Teaching lectures.Analytical thinking skills are an essential element in supporting the competency development of prospective PE teachers sustainably. Regarding the three indicators, namely differentiating, organizing, and attributing, lecturers use instruments to measure and assess specific analytical thinking skills for Micro Teaching lectures practically and contextually.

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