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PRINCIPAL COMPONENT ANALYSIS OF VOCATIONAL TEACHER COMPETENCY IN EAST SERAM REGENCY

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Abstract

Abstract. This research aims to identify the dominant factors that shape the competence of vocational teachers in the region. The variables studied include: (X1) Understanding of educational insight or foundations; (X2) Understanding of students; (X3) Curriculum or syllabus development; (X4) Instructional design; (X5) Mastery of learning technology; (X6) Implementation of educational and dialogic learning; (X7) Evaluation of learning outcomes; (X8) Development of students to actualize their various potentials; (X9) Learning management skills; (X10) Use of multimedia in learning; (X11) Application of didactic-methodological principles; (X12) Ability to evaluate and develop effective tests; (X13) Acting in accordance with religious, legal, social, and Indonesian national cultural norms; (X14) Displaying an honest and noble character; (X15) Behaving maturely and authoritatively; (X16) Demonstrating a strong work ethic, responsibility, pride in being a teacher, and self-confidence; (X17) Ability to uphold the teacher's code of ethics; (X18) Non-discriminatory attitude in learning management; (X19) Interpersonal communication skills; (X20) Adapting to socio-cultural diversity; (X21) Multi-dimensional professional communication skills. The collected data were then analyzed using Principal Component Analysis (PCA) to reveal the variables that influence the competence of vocational teachers in East Seram Regency. From the 21 variables, 5 variables with an MSA value below 0.5 were eliminated. After the extraction process, 5 dominant factors were obtained: Skills, Integrity, Innovation, Knowledge, and Attitude.

Keywords: Principal Component Analysis, Competency, Vocational Teachers

INTRODUCTION

Education is recognized as a fundamental right of every individual, as stipulated in the 1945 Constitution Article 31 paragraph 1, which asserts that every state ensures the individual's right to receive education (Hidayah & Kuntjoro, 2022). Education is viewed as a series of processes that empower potential and competencies, create quality individuals, and occur throughout life, from childhood to adulthood, even into old age. Education is accessed through various sources, including family, community, school, and the surrounding environment. In this context, education is considered an illumination that guides individuals in determining the direction, purpose, and meaning of life (Fricticarani et al., 2023). This helps individuals realize their potential and develop it. The primary goal is to prepare individuals to explore, discover,

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and hone their inherent potential and develop each individual's unique characteristics (Amalida & Halimah, 2023).

Education is not only a national issue in Indonesia but also a global spotlight. Therefore, education has become one of the 17 Sustainable Development Goals (SDGs), focusing on SDG 4, which aims to provide inclusive, equitable education and lifelong learning opportunities for all individuals (Muthmainnah et al., 2025). Education also plays a crucial role in the development of Human Resources (HR) aimed at building HR that is hardworking, dynamic, productive, knowledgeable, and skilled in technology, with support from industry and global talent. Improving the quality and competitiveness of HR involves humans who are healthy, intelligent, adaptive, innovative, skilled, and have strong character (Muthmainnah et al., 2025). Teachers, or educators, are a key component in improving the quality of education in schools (Nevira & Putri, 2023). One of the main factors determining the quality of education is professional teachers who are able to carry out teaching tasks with full responsibility. Teachers hold a strategic position in the education system (Achmady, 1995 in Kempa, 2019:2). Teachers are an important component in education, as they guide learners to achieve the established goals (Salam et al., 2022).

Law No. 14 of 2005 concerning Teachers and Lecturers identifies teachers as professional educators responsible for educating, teaching, guiding, assessing, and evaluating learners at various levels of education. As professional educators, teachers are expected to always carry out teaching tasks as best as possible. Constructive and effective teacher performance in teaching has a positive impact on student learning achievement Pradana et al. (2022) emphasizes that a person who is able to perform their professional duties well can be considered a professional. In the context of the teaching profession, a teacher is expected to perform their professional duties well to be considered a professional teacher. The formation of a professional teacher involves education appropriate to their field of duty. These two factors complement each other to produce a professional teacher.

However, in practice, achieving the status of a professional teacher is not always easy for all teachers. Some teachers may have been placed in suitable fields but are not yet able to perform their duties well. On the other hand, there are teachers who may be able to perform their duties and roles in teaching well but lack qualifications appropriate to their field of duty, so teacher professionalism has not been fully achieved. As educators, teachers, and guides, teachers require strong knowledge to perform their duties well (Giovanni & Ali, 2024). Law No. 14 of 2005 Article 8 concerning Teachers and Lecturers outlines the characteristics of teachers, including academic qualifications, competence, educator certification, physical and mental health, and the ability to achieve national education goals. (Ramadhan, 2019) views that a professional teacher must possess pedagogical competence, personality competence, professional competence, and social competence.

Teacher competence refers to the collection of knowledge, skills, and behaviors that must be possessed, internalized, and mastered by teachers in carrying out their duties (Suprapto et al., 2022). In addition, teacher competence also encompasses a combination of personal abilities, knowledge, technology, social, and spiritual aspects that together form the teaching profession (Andriani et al., 2024). The execution of a teacher's duties in teaching demands that the teacher possess various competencies, especially pedagogical competence. To obtain this competence, teachers must undergo education at Educational Personnel Education Institutions

(LPTK). Unfortunately, there are still many teachers who do not have an LPTK diploma or obtained their LPTK diploma in a less appropriate manner (Sholeh & Efendi, 2023).

The results of the Teacher Competency Test (UKG) published in the National Education Balance Sheet in 2016 show that the national UKG scores for teachers are still low. The national average UKG score for teachers was 56.69. In Maluku Province, the average UKG score was 47.38, and in East Seram Regency, the average UKG score was 43.11. Specifically for teachers teaching at Vocational High Schools (SMK), the national average UKG score was 58.30, in Maluku Province 51.24, and in East Seram Regency 50.36. Therefore, teacher competence in East Seram Regency is still considered low. However, it should be noted that UKG results only reflect some aspects of teacher competence, such as pedagogical and professional competence, while teacher competence also encompasses various other aspects, including personality and social competence.

The low UKG scores are caused by a number of factors. Preliminary interviews with SMK teachers in East Seram Regency in August 2022 revealed that the lack of training for improving the competence of vocational teachers is one of the factors causing low UKG scores. Some teachers revealed that during their tenure as teachers, they had never participated in training activities for teacher competence improvement. Observations also revealed that some vocational teachers, especially in the field of agriculture, teach subjects that do not match their academic qualifications. In this context, a teacher must possess pedagogical and professional competence appropriate to their field of expertise to be able to carry out duties and roles in the teaching-learning process (Nikmatuloh & Efendi, 2024). Another issue is that all agriculture vocational teachers in the regency do not yet have an LPTK diploma. Furthermore, observation results show that agriculture vocational teachers acknowledge their non-participation in the activities of the Subject Teacher Forum (MGMP) community for SMK Agribusiness of Food Crops and Horticulture. In fact, the MGMP community is a forum that can facilitate meetings among subject teachers to develop their professionalism as well as influence their social competence.

These factors, along with issues such as teacher morale when entering school, the use of agriculture laboratories, the use of innovation in teaching, and the implementation of practical lessons for agriculture vocational subjects, affect the competence of vocational teachers. Therefore, this research aims to identify the dominant factors that shape the competence of vocational teachers in East Seram Regency. Thus, this research aims to provide a deeper understanding of the competence of vocational teachers in East Seram Regency and contribute to efforts to improve the quality of vocational education in the region.

IMPLEMENTATION METHOD

This study was carried out over three months from February to May 2023 across five vocational high schools in East Seram Regency, targeting a population of 81 vocational teachers. Using purposive sampling, 30 qualified teachers with at least one semester of experience in teaching specific vocational subjects were selected as respondents (Ardiansyah et al., 2023). Data collection employed a validated and reliable Likert-scale questionnaire to assess 21 distinct variables encompassing pedagogical skills, professional integrity, and social competencies essential for vocational teacher effectiveness.

Table 1: Results of Validity and Reliability Tests for Research Instruments

Variable	Number of Instrument Items Before Test	Number of Instrument Items After Test	Validity Value	Decision	Reliability Value	Decision
X1	5	5	.635 – .860	Valid	0.776	Reliable
X2	5	5	.546 - .687	Valid	0.582	Reliable
X3	5	5	.399 – .862	Valid	0.812	Reliable
X4	5	5	.595 - .860	Valid	0.809	Reliable
X5	5	5	.635 - .896	Valid	0.780	Reliable
X6	5	5	.692 - .745	Valid	0.748	Reliable
X7	5	5	.399 - .911	Valid	0.812	Reliable
X8	5	5	.451 - .705	Valid	0.489	Reliable
X9	5	5	.523 - .683	Valid	0.535	Reliable
X10	5	5	.400 - .707	Valid	0.506	Reliable
X11	5	5	.543 - .775	Valid	0.668	Reliable
X12	5	5	.418 - .873	Valid	0.755	Reliable
X13	5	5	.461 - .817	Valid	0.612	Reliable
X14	5	5	.482 - .759	Valid	0.692	Reliable
X15	5	5	.484 - .863	Valid	0.741	Reliable
X16	5	5	.452 - .769	Valid	0.743	Reliable
X17	5	5	.482 - .871	Valid	0.760	Reliable
X18	5	5	.554 - .880	Valid	0.788	Reliable
X19	5	5	.569 - .678	Valid	0.546	Reliable
X20	5	5	.365 - .907	Valid	0.794	Reliable
X21	5	5	.492 - .815	Valid	0.618	Reliable

After obtaining valid and reliable instruments, the instruments were then used for data collection by distributing research instruments to 30 respondents in 5 schools. The data obtained were first tested using the Bartlett test and the Keyser Meyer Olkin (KMO) test. Finally, the Measures of Sampling Adequacy values were checked and then analyzed using Principal Component Analysis.

RESULTS AND DISCUSSION

Data Pre-Processing

Before conducting Principal Component Analysis, prerequisite tests were performed on the obtained data, including sample feasibility and adequacy. A sample is considered feasibility if the Bartlett's χ value is <0.05. For sample adequacy, a KMO value close to 1 indicates feasibility (Table 2).

Table 2. Assessment of KMO Test Results

KMO Value	Interpretation (Factor Analysis)
0.90 < KMO ≤1.00	Data is very good
0.80 < KMO ≤ 0.90	Data is good
0.70 < KMO ≤ 0.80	Data is fair
0.60 < KMO ≤ 0.70	Data is acceptable
0.50 < KMO ≤0.60	Data is poor
KMO ≤ 0.50	Data is unacceptable

Source: Hardisman, 2021.

The PCA procedure began with assessing the suitability of the data. The Bartlett's test of sphericity was significant, confirming the factorability of the correlation matrix. However, the KMO value of 0.577 indicated the overall sample adequacy was 'poor'. Consequently, to refine the variable set, the Measures of Sampling Adequacy (MSA) for each variable were examined using the Anti-Image Correlation Matrix. Variables with MSA values below the 0.5 threshold were deemed unsuitable and eliminated to ensure the validity of the subsequent factor extraction.

Tabel 4. Rekap Matriks Anti-Image

Variabel	Nilai MSA Pengujian Ke-					
	1	2	3	4	5	6
X_1	.546[a]	.515[a]	.561[a]	.566[a]	.510[a]	.505[a]
X_2	.499[a]	.777[a]	.763[a]	.755[a]	.741[a]	.748[a]
X_3	.830[a]	.769[a]	.764[a]	.752[a]	.740[a]	.827[a]
X_4	.648[a]	.660[a]	.692[a]	.640[a]	.635[a]	.624[a]
X_5	.538[a]	.583[a]	.615[a]	.566[a]	.564[a]	.583[a]
X_6	.400[a]	.476[a]	.481[a]	**.452[a]**		
X_7	**.357[a]**					
X_8	.769[a]	.813[a]	.801[a]	.834[a]	.823[a]	.811[a]
X_9	.408[a]	.644[a]	.606[a]	.767[a]	.856[a]	.860[a]
X_{10}	.512[a]	.593[a]	.591[a]	.684[a]	.665[a]	.648[a]
X_{11}	.519[a]	.671[a]	.611[a]	.589[a]	.659[a]	.654[a]
X_{12}	.416[a]	.461[a]	**.441[a]**			
X_{13}	.526[a]	.549[a]	.495[a]	.466[a]	**.450[a]**	
X_{14}	.532[a]	.614[a]	.632[a]	.607[a]	.632[a]	.647[a]
X_{15}	.570[a]	.644[a]	.652[a]	.755[a]	.737[a]	.716[a]
X_{16}	.581[a]	.562[a]	.557[a]	.649[a]	.623[a]	.620[a]
X_{17}	.712[a]	.683[a]	.698[a]	.676[a]	.786[a]	.790[a]
X_{18}	.792[a]	.762[a]	.771[a]	.793[a]	.799[a]	.801[a]
X_{19}	.824[a]	.866[a]	.841[a]	.776[a]	.750[a]	.779[a]
X_{20}	.607[a]	.614[a]	.598[a]	.667[a]	.644[a]	.622[a]
X_{21}	.405[a]	**.408[a]**				
Nilai KMO	0,577	0,647	0,652	0,686	0,696	0,705

Barlett	Chi Square	497,206	450,525	426,536	394,623	365,563	349,781
test	Df	210	190	171	153	136	120
	Sig.	0,000	0,000	0,000	0,000	0,000	0,000

Source: IBM SPSS 25 Processed Results

To ensure robust factor extraction, five variables with MSA values below 0.5 were eliminated from the analysis. These were 'Evaluation of Learning Outcomes' (X7), 'Communication Skills' (X21), 'Ability to Evaluate and Develop Effective Tests' (X12), 'Implementation of Educational and Dialogic Learning' (X6), and 'Acting in Accordance with Religious, Legal, Social, and Indonesian National Cultural Norms' (X13). Following this purification, the overall sample adequacy improved, as reflected in a recalculated KMO value of 0.601, which falls into the 'more than acceptable' category.

Principal Component Analysis

a. Extraction

Extraction is a step in factor analysis, which reduces a number of original variables into a smaller number of factors. Factor extraction was performed using the Principal Component method. In this research, to obtain the extraction results, attention was given to the communality values and Eigenvalues. Communality is the variance contributed by a variable with all other variables in the analysis. It can also be referred to as the proportion or share of variance accounted for by common factors. The communality values are presented in Table 5.

Table 5. Communalities

	Initial	***Extraction***
X_1	1,000	0,881
X_2	1,000	0,787
X_3	1,000	0,791
X_4	1,000	0,814
X_5	1,000	0,812
X_8	1,000	0,746
X_9	1,000	0,578
X_{10}	1,000	0,876
X_{11}	1,000	0,886
X_{14}	1,000	0,685
X_{15}	1,000	0,899
X_{16}	1,000	0,866
X_{17}	1,000	0,901
X_{18}	1,000	0,824
X_{19}	1,000	0,726
X_{20}	1,000	0,900

Source: IBM SPSS 25 Processed Data Results

Variabel X17 memiliki nilai komunalitas tertinggi yaitu 0,901. Hal ini berarti variabel ‘menjunjung kode etik guru’ dapat menjelaskan sebanyak 90,1% variasi faktor yang terbentuk dalam analisis. Sebaliknya, variabel X9 memiliki nilai komunalitas terendah yaitu 0,578.

Variabel ‘pengembangan peserta didik untuk mengaktualisasikan potensi yang dimilikinya’ hanya dapat menjelaskan sebanyak 60,9% variasi faktor yang terbentuk dalam analisis.

Table 6 Total Variance Explained

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
comp 1	7,085	44,281	44,281
comp 2	2,084	13,028	57,309
comp 3	1,471	9,191	66,500
comp 4	1,318	8,235	74,735
comp 5	1,014	6,340	81,074
comp 6	0,666	4,163	85,237
comp 7	0,522	3,261	88,499
comp 8	0,429	2,680	91,179
comp 9	0,380	2,377	93,556
comp 10	0,284	1,774	95,329
comp 11	0,276	1,725	97,055
comp 12	0,179	1,122	98,176
comp 13	0,121	0,757	98,933
comp 14	0,105	0,654	99,587
comp 15	0,051	0,321	99,908
comp 16	0,015	0,092	100,000

The extraction process yielded five principal components with eigenvalues exceeding 1, which together account for 81.074% of the total variance in the data. The first and most significant factor (PC1) explains 44.281% of the variance, while the subsequent factors (PC2 to PC5) contribute 13.028%, 9.191%, 8.235%, and 6.340%, respectively. This result indicates that these five components effectively capture the majority of the information from the original set of variables, providing a solid basis for the subsequent factor rotation and interpretation.

b. Rotation

Factor rotation is performed to obtain complete information regarding the variables contained within each formed factor, or variables that can truly serve as indicators of vocational teacher competency. Therefore, rotation (transformation) into a simpler matrix using the varimax (variance of maximum) rotation method is necessary. By rotating the entire factor loadings, a more accurate data structure can be produced.

Table 7. Rotated Component Matrix

Variabel	*Principal Component*				
	1	**2**	**3**	**4**	**5**
X_1	0,109	0,223	0,006	**0,898**	0,118
X_2	**0,552**	0,053	0,386	0,536	0,214
X_3	**0,712**	-0,152	0,367	0,332	0,108
X_4	0,203	-0,011	**0,855**	0,113	0,170
X_5	0,280	0,159	**0,795**	0,036	-0,275
X_8	**0,832**	0,132	0,065	-0,003	0,182
X_9	**0,837**	0,266	0,187	0,073	-0,253
X_{10}	0,123	0,405	**0,591**	-0,086	0,206
X_{11}	**0,621**	0,526	0,339	-0,191	0,100
X_{14}	0,203	0,442	0,340	-0,351	**0,457**
X_{15}	**0,823**	0,406	0,183	0,145	-0,041
X_{16}	0,102	**0,847**	-0,010	0,073	0,363
X_{17}	0,183	**0,795**	0,357	0,286	-0,163
X_{18}	0,018	0,246	0,034	0,224	**0,880**
X_{19}	**0,630**	0,534	0,188	0,017	0,088
X_{20}	0,329	**0,858**	0,028	0,135	0,192

Source: IBM SPSS 25 Processed Data Results

Following varimax rotation, the five extracted factors revealed clear and interpretable groupings of variables. The first factor (PC1) exhibited strong loadings from variables related to pedagogical execution, such as learning management skills, student development, and application of teaching principles, leading to its interpretation as 'Skills'. The second factor (PC2) clustered variables concerning professional ethics, work ethic, and socio-cultural adaptation, thus being labeled 'Integrity'. The third factor (PC3) was defined by high loadings on instructional design and technology mastery, earning the name 'Innovation'. The fourth (PC4) was dominated solely by the foundational knowledge variable, aptly named 'Knowledge'. Finally, the fifth factor (PC5) combined variables related to fairness and personal virtue, constituting the 'Attitude' dimension.

c. Interpretation

Interpretation is used to recognize/identify the variables contained within a factor. In this stage, each factor will be named/labeled for easier recognition based on the information obtained from the rotated factor matrix, from Table 7. Factor 1 has high coefficients for variables X2 (Understanding of students), X3 (Curriculum or syllabus development), X8 (Development of students to actualize their various potentials), X9 (Learning management skills), X11 (Application of didactic-methodological principles), X15 (Behaving maturely and authoritatively), X19 (Interpersonal communication skills). Therefore, Factor 1, based on X2, X3, X8, X9, X11, X15, and X19, can be named 'Skills'. Factor 2 has high coefficient values for variables X16 (Demonstrating a work ethic, being responsible and having pride in being a teacher and self-confidence), X17 (Ability to uphold the teacher's code of ethics), X20 (Adapting to socio-cultural diversity). Therefore, Factor 2, based on X14, X16, X17, and X20, can be named 'Integrity'.

Factor 3 has high coefficient values for variables X4 (Instructional design), X5 (Mastery

of learning technology), and X10 (Use of multimedia in learning). Therefore, Factor 3, based on X4, X5, and X10, can be named 'Innovation'. Factor 4 has a high coefficient value for variable X1 (Understanding of educational insight or foundations). Therefore, Factor 4, based on X1, can be named 'Knowledge'. Factor 5 has high coefficient values for variables X14 (Displaying an honest and noble character), X18 (Non-discriminatory attitude in learning management). Therefore, Factor 5, based on X18, can be named 'Attitude'.

Table 9. Factor Interpretation

Kode	Variabel	*Loading value*	Katagori Faktor	Nama Faktor
X_2	Understanding of students	0,536	1	Skills
X_3	Curriculum or syllabus development	0,712		
X_8	Developing students to actualize their various potentials	0,832		
X_9	Learning management skills	0,837		
X_{11}	Application of didactic-methodical principles	0,823		
X_{15}	Behave maturely and with dignity	0,621		
X_{19}	Interpersonal communication skills	0,630		
X_{16}	Demonstrate work ethic, be responsible and have a sense of pride in being a teacher and self-confidence	0,847	2	Integrity
X_{17}	Able to uphold the teacher's code of ethics	0,795		
X_{20}	Adapting to socio-cultural diversity	0,854		
X_4	Learning planning	0,855	3	Innovation
X_5	Mastery of learning technology	0,795		
X_{10}	The use of multimedia in learning	0,591		
X_1	Understanding of educational insight or foundation	0,898	4	Knowledge
X_{14}	Showing an honest and noble personality	0,442	5	Attitude
X_{18}	Be non-discriminatory in managing learning	0,880		

Principal Component Analysis of vocational teacher competence in East Seram Regency identified five dominant factors: Skills, Integrity, Innovation, Knowledge, and Attitude (Sholeh & Efendi, 2023). The 'Skills' factor is central, encompassing learning management, student development, curriculum design, and interpersonal communication, reflecting a teacher's role as both an instructor and a holistic guide (Fatchurrohman & Aisyanti, 2022). 'Integrity' comprises ethical conduct, adaptability to socio-cultural diversity, professional pride, and adherence to the teacher's code of ethics, forming the moral foundation of the profession (Yuliani & Prasojo, 2025). Concurrently, the 'Innovation' factor highlights the necessity for creative instructional design and mastery of educational technology to create dynamic and relevant learning experiences. 'Knowledge' is defined by a deep understanding of educational foundations, enabling teachers to make informed pedagogical decisions (Singgih & Sulistyono, 2020). The 'Attitude' factor emphasizes fairness, inclusivity, and personal integrity as crucial for fostering a supportive classroom environment. These findings provide a comprehensive framework for understanding the multidimensional nature of teacher competence (Singgih & Sulistyono, 2020). Consequently, the research offers an in-depth view of the key dimensions essential for teacher professional development. The implications point towards a need for balanced development across these five areas to improve overall educational quality (Jadid & Mahdani, 2022).

The research yields specific implications and suggestions for various stakeholders aimed at enhancing vocational teacher quality. For relevant institutions, the primary recommendation is to enhance training programs by increasing their frequency and quality, with a focused emphasis on developing identified competencies in skills and integrity (Fitriati & Yustini, 2023). Institutions must also provide access to the latest educational technology and training to foster innovation among teachers. Additionally, they should ensure policies promote inclusive and non-discriminatory learning practices. For vocational teachers themselves, proactive engagement in continuous professional development through both formal training and self-directed learning is advised (Rahmawati & Surur, 2024). Teachers are encouraged to collaborate with peers to share effective strategies and maintain an open attitude toward new teaching methodologies. For future researchers, the study opens avenues for deeper exploration into specific competence aspects, such as technology integration, or for examining how regional contexts influence these factors. Utilizing varied methodological approaches like case studies could further enrich the understanding of on-ground realities. Ultimately, these targeted efforts are expected to empower competent, ethical, and innovative teachers, thereby contributing to better educational outcomes in the region (Pardamean, 2024).

CONCLUSION

Based on the results of the analysis in this study, several dominant factors were obtained that shape teacher competency in East Seram Regency, including: Skills Factors (Understanding of students, curriculum or syllabus development, student development to actualize various competencies they have, learning management skills, application of didactic-methodical principles, mature and authoritative behavior, interpersonal communication skills), Integrity Factors (demonstrating work ethic, being responsible and having a sense of pride in being a teacher and self-confidence, being able to uphold the teacher's code of ethics, and adapting to socio-cultural diversity), Innovation Factors (Learning Design; mastery of learning technology; and Use of multimedia in learning.), Knowledge Factors (Understanding of educational insights or foundations.) and 5 Attitude Factors (Being non-discriminatory in learning management, as well as variables displaying honest and noble personalities)

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