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Construct Validity of Teaching Practice Assessment Instrument: A CFA Approach at ICFP Baucau

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A B S T R A C T

This study aims to examine the construct validity of the Teaching Practice Assessment Instrument, focusing on the "Preparation for Teaching" component, using the Confirmatory Factor Analysis (CFA) approach. Data were collected from 350 teacher education students participating in internship programs at the Instituto Católico para a Formação de Professores (ICFP) Baucau, Timor-Leste. The model was estimated using the Maximum Likelihood (ML) method with the NLMINB algorithm and achieved convergence after 28 iterations. The results indicated a good model fit (χ^2/df = 2.039, RMSEA = 0.054, CFI = 0.979, TLI = 0.958, SRMR = 0.029). All indicators showed significant factor loadings (0.429–0.721) and moderate to strong determination coefficients (R^2 = 0.184–0.520). These findings confirm that the "Preparation for Teaching" instrument is valid and reliable for assessing preservice teachers' readiness for classroom instruction. Further research is recommended to refine the indicators and examine measurement invariance across different internship stages

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INTRODUCTION

Teacher education is one of the fundamental components in efforts to improve the quality of education in various countries. Teachers not only play the role of transmitters of knowledge, but also as agents of social change that shape the character, values, and mindset of students (Ahmad, Santos, 2025; Ahmad, 2025). Therefore, the process of forming a professional teacher must be systematically and comprehensively designed through a series of learning experiences that balance between theoretical aspects and hands-on practice in the field. One of the important components of teacher education that emphasizes real experience and professional reflection is the internship program or teaching practice (Granziera et al., 2023; Mania & Alam, 2021).

The internship program serves as a bridge between the pedagogical theory obtained by prospective teachers in higher education and the reality of learning practices in schools (Anjum, 2020; Edwar et al., 2022). Through this activity, prospective teachers can hone their teaching skills, understand classroom dynamics, and develop the ability to reflect on their learning practices. In assessment in the internship program, it is a systematic evaluation process to measure the abilities, skills, and knowledge gained by students during field practice as an integral part of the teacher education curriculum. This is in line with the view Álvarez-Álvarez & Falcon, (2023) which emphasizes that the assessment of teaching practice must be able to provide a comprehensive picture of the professional development of prospective teachers, with a focus on the achievement of competencies relevant to their scientific field.

In the context of developing countries such as Timor-Leste, the implementation and assessment of internship programs has a high urgency. As a relatively young country with a growing education system, Timor-Leste faces a major challenge in preparing competent and professional teachers. One of the institutions that has a strategic role in preparing quality educators in the country is the Instituto Católico para a Formação de Professores (ICFP) located in Baucau. The institution is committed to producing teachers who are able to teach effectively in the country's two official languages, Portuguese and Tetun, while upholding the local ethical and cultural values that are the foundation of Timor-Leste's national education system (Quinn & Buchanan, 2022) .

In the structure of the teacher education curriculum at ICFP, internship programs or teaching practices are core elements that must be followed by every prospective teacher student. The program is designed to provide an authentic experience at school, where students can apply learning theory, manage classes, and interact directly with students (Aly, 2020; Usmaedi, 2021). Through this experience, prospective teachers are expected to build a contextual understanding of the reality of education in Timor-Leste. However, to ensure that this program is truly effective in developing the competencies of prospective teachers, a valid, reliable, and appropriate assessment instrument is needed in accordance with the characteristics of the local educational context. The internship program at ICFP Baucau is carried out three times during the three-year study period, namely in semesters two, four, and six. This gradual implementation is intended so that students can experience a progressive increase in responsibility, starting from the observation stage, the guided practice stage, to the independent practice stage at partner schools. This gradual model provides opportunities for prospective teachers to build confidence and develop pedagogical skills and professionalism gradually.

The assessment instruments used at ICFP Baucau consist of seven main aspects and forty indicators that are used to assess student performance during teaching practice. These seven aspects cover all dimensions of teaching skills, from lesson planning to post-teaching reflection. These aspects include: (1) preparation for teaching, (2) introductory presentation, (3) presentation of lesson explanations, (4) pedagogical skills, (5) participation based on gender and special needs, (6) assessment during lessons, and (7) presentation of lesson conclusions. These seven aspects form a unit that represents the ability of prospective teachers to design, implement, and evaluate the learning process as a whole.

The development of the assessment instrument is based on the theory of Pedagogical Content Knowledge (PCK) introduced by Shulman, 1986). PCK describes a special form of knowledge that distinguishes teachers from experts in the field of pure science. Shulman explained that a good teacher must not only master the content of the material, but also must understand how to present the material so that it can be easily understood by students. Thus, PCK is a combination of content knowledge and pedagogical knowledge that allows teachers to transform academic concepts into meaningful learning experiences for students.

In the context of teacher education, PCK is an important foundation in assessing the extent to which prospective teachers are able to integrate learning theory and practice. Gess-Newsome et al., (2019) emphasized that PCK is the main indicator of teacher professionalism because it reflects the teacher's ability to bridge the gap between academic theory and real needs in the classroom. Therefore, the application of the PCK concept in the assessment of teaching practice at ICFP Baucau has a strong and strategic relevance to measure the pedagogical ability of prospective teachers.

Although the assessment instrument has been used regularly at ICFP Baucau, until now no empirical tests have been carried out to ensure the validity of its construct. In fact, construct validity is a fundamental component in the development of instruments because it determines the extent to which the instrument actually measures the theoretical construct in question (Cronbach & Meehl, 1955). Without adequate construct validity, assessment results can be biased and cannot be used as a strong basis for academic decision-making (Messick, 1995). In the context of teacher education, construct validity is very important because the results of the assessment of prospective teachers have long-term implications for the quality of education as a whole.

Previous research has shown that many teaching practice assessment instruments in developing countries are developed without a strong empirical basis (Tigelaar et al., 2004; Darling-Hammond & Bransford, 2005). As a result, the results of assessments often do not reflect the true abilities of prospective teachers. Therefore, this study aims to close this gap by conducting quantitative construct validity testing through Confirmatory Factor Analysis (CFA).

CFA is part of Structural Equation Modeling (SEM) which is used to confirm the factor structure of an instrument based on a predetermined theoretical model (Byrne, 2010; Kline, 2015). Through CFA, researchers can test the fit between empirical data and the underlying conceptual model. Thus, the application of CFA in this study aims to ensure that the seven aspects in the internship assessment instrument actually form a single construct that is valid and theoretically consistent. This approach has been widely used in teacher education research to assess the validity of instruments related to pedagogic competence, professionalism, and teaching readiness (Tschannen-Moran & Woolfolk Hoy, 2001; Morrell et al., 2013).

This study aims to analyze the validity of the construct of the internship program assessment instrument at ICFP Baucau, Timor-Leste, as well as to confirm the structure of seven aspects of assessment based on the theoretical model of Pedagogical Content Knowledge (PCK). In addition, this study is expected to provide recommendations for improving the instrument so that it can be used as a standard assessment tool in teacher education programs at ICFP and similar institutions in Timor-Leste. Academically, this research contributes to the development of knowledge in the field of teacher education evaluation, especially in the context of developing countries. Practically, the results of this study are expected to assist ICFP Baucau in improving the objectivity, reliability, and fairness in assessing prospective teachers, as well as strengthening the quality assurance system of teacher education in Timor-Leste.

This research is focused on the validity test of the construct of the assessment instrument used in the ICFP Baucau internship program. The research data was obtained from prospective teacher students who participated in three stages of internships and analyzed using the Confirmatory Factor Analysis (CFA) method to test the suitability of the theoretical model with empirical data. This study does not include the test of content validity or criterion validity because the main focus is to confirm the factor structure of the assessment instrument. With this approach, the results of the study are expected to provide strong empirical evidence on the validity of the construct of the instrument and support the improvement of the quality of the evaluation system of teaching practices of prospective teachers in Timor-Leste.

LITERATURE REVIEW

Construct validity is an important element in the development of Education assessment instruments (Helmiyatun, 2025; Taqiudin & Ahmad, 2025). According to Smith, (2005), the validity of the construct indicates the extent to which an instrument actually measures the theoretical concept intended. In the context of an internship program or field practice of prospective teachers, the validity of the construct guarantees that each assessment item reflects the abilities and competencies that the intern should have. One of the widely used approaches to test the validity of constructs is Confirmatory Factor Analysis (CFA). The CFA allows researchers to confirm the relationship between indicators and theoretical constructs based on pre-established models (Hajjina &

Retnawati, 2022; Kolenikov, 2009; Norwalk et al., 2014). The analysis also provides a measure of the suitability of models such as CFI, RMSEA, and Chi-square that determine whether the empirical data support the theoretical model (Fallon et al., 2023).

In educational research, CFA has been used to ensure the reliability and consistency of evaluation instruments. Hubona et al., (2021) affirms that the CFA is important for verifying the structure of the expected factors and reinforcing the validity of the measurement model. In the context of teacher training, this analysis helps to ensure that the assessment instrument truly measures the pedagogical, professional, and social competence of prospective teachers. The internship program at the Instituto Católico para a Formação de Professores (ICFP) Baucau has the main objective of forming competent professional teacher candidates in the fields of pedagogic, science, and work ethics. Therefore, the assessment instruments used need to be tested for validity so that the results of the evaluation truly reflect the ability of the students, not the subjectivity of the assessor.

METHODOLOGY

This study uses a quantitative approach with the Confirmatory Factor Analysis (CFA) method to test the validity of the construct of the assessment instrument of the ICFP Internship Program Baucau, Timor-Leste. CFA was chosen because it is able to confirm the structure of factors that have been theoretically designed based on the concept of teacher competence and ensure the compatibility between indicators in forming the measured construct. The subject of the study is a student of the teacher education program at the Instituto Católico para a Formação de Professores (ICFP) Baucau, who is carrying out an internship program at partner schools. The number of respondents in this study was 350 students, who came from the three stages of internship implementation in semesters two, four, and six. Respondents were selected purposively based on their active involvement in teaching practice activities.

The research data was obtained through the dissemination of internship assessment instruments developed based on one main indicator, namely "Preparation for Teaching." This indicator was chosen because it reflects the basic skills that must be possessed by prospective teachers before carrying out the learning process. This instrument consists of five statements, namely: (1) preparing the material needed in the lesson, (2) preparing oneself to teach by reading the stages and content of the lesson before teaching, (3) punctuality in starting the lesson according to the schedule, (4) the ability to arrange tables, chairs, and students before the lesson starts, and (5) readiness in determining the topic of the lesson to be taught. The collected data is then analyzed using Confirmatory Factor Analysis (CFA) with the help of the latest version of AMOS software. The analysis was carried out through several stages, including testing the goodness of fit indices (CFI, GFI, RMSEA, and Chi-square/df) to determine the extent to which the model is consistent with the empirical data. In addition, the reliability of the construct was tested through composite reliability (CR) and average variance extracted (AVE) values, to ensure internal consistency between statements.

The results of the CFA analysis are used to assess the extent to which each statement item represents the "Preparation for Teaching" indicator in a valid and reliable manner. Thus, the results of this study are expected to provide a strong empirical basis for the improvement of the internship assessment instrument at ICFP Baucau and can be used more widely in the context of developing the competency of prospective teachers in Timor-Leste.

RESULT

CFA Model Summary

To test the suitability of the Preparation for Teaching or Preliminary Understanding of Mentoring (PUM) construct model with empirical data, a Confirmatory Factor Analysis (CFA) analysis was carried out using *the lavaan* program version 0.6–19. This analysis aims to ensure that the indicators used truly represent the latent construct being measured. Parameter estimation is carried out using the Maximum Likelihood (ML) method which is considered efficient for normally distributed data, using the NLMINB optimization algorithm to achieve stable convergence. A summary of the characteristics of the PUM construct CFA model including estimators, optimization methods, number of parameters, number of observations, and number of iterations is presented in the following Table 1.

Table 1**.** Summary of the PUM Construct CFA Model

Component	**Value**
Estimator	Maximum Likelihood (ML)
Optimization methods	NLMINB
Number of parameters	10
Number of observations	350
Number of iterations	28

The results of the Confirmatory Factor Analysis (CFA) analysis in table 1 show that the estimation process of the Preparation for Teaching PUM construct model runs optimally and stably. Estimation is carried out using the Maximum Likelihood (ML) method which is known to be effective in producing efficient estimation parameters on multivariate normal distributed data. The model optimization process is carried out with the NLMINB algorithm, which serves to accelerate convergence through a numerical approach based on nonlinear function minimization.

The PUM construct model was estimated with 10 parameters, using data from 350 respondents, and achieved convergence after 28 iterations. This condition shows that the model does not experience estimation errors such as non-positive definite matrix or Heywood case, so that the analysis process is declared successful. The number of samples used also met the sample adequacy criteria for CFA analysis, which is at least five to ten times the estimated number of parameters. Thus, the results of this estimate can be trusted to be analyzed further at the goodness of fit testing stage.

Model Fit

After the PUM construct CFA model has been successfully estimated, the next step is to evaluate the level of model suitability (goodness of fit) to ensure that the developed model is in accordance with empirical data. The assessment of model suitability was carried out using several main indices, namely Chi-square (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). In addition, the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and Sample-size Adjusted BIC (SABIC) values are also included as the basis for alternative model comparison. A complete summary of the conformity test results of the PUM construct CFA model is presented in Table 2 below.

Table 2. Model Fit Index

Index	Value	Fit Criteria	Interpretation
Chi-square (χ^2)	10.197	p > 0.05	Fit (insignificant)
Degree of freedom (df)	5		
p-value (χ^2)	0.070	> 0.05	Data-driven models
χ^2/df	2.039	< 3	Fit
RMSEA	0.054	< 0.08	Fit
90% CI RMSEA	0.000 – 0.103		Still in good range
P(RMSEA≤ 0.05)	0.374	> 0.05	Accepted
CFI	0.979	≥ 0.90	Excellent
TLI	0.958	≥ 0.90	Good
SRMR	0.029	≤ 0.08	Excellent
AIC	2189.188	—	For model comparison
BIC	2227.768	—	For model comparison
SABIC	2196.044	—	Customized sample size

The results of the Confirmatory Factor Analysis (CFA) analysis of the PUM construct in table 2 show that the tested model has a good level of conformity with empirical data. Based on the test results, a Chi-square value (χ^2) of 10.197 was obtained with a degree of freedom (df) = 5 and p-value = 0.070 (> 0.05), which shows that there is no significant difference between the model covariance matrix and the empirical data. Thus, the CFA model is declared according to the data (model fit). The χ^2/df ratio of 2.039, which is below the maximum limit of 3, also indicates a good level of model suitability. The Root Mean Square Error of Approximation (RMSEA) value of 0.054 with a 90% confidence interval between 0.000–0.103 indicates that the model's approximation error rate is relatively small and still in the good category. In addition, a p(RMSEA value ≤ 0.05) of 0.374 (> 0.05) reinforces that the model is acceptable.

Furthermore, the incremental fit index showed very satisfactory results, where the Comparative Fit Index (CFI) reached 0.979 and the Tucker-Lewis Index (TLI) reached 0.958, both above the threshold value of 0.90 which signifies excellent model suitability. The Standardized Root Mean Square Residual (SRMR) value of 0.029 is also well below the maximum limit of 0.08, indicating that the difference between the model covariance and the empirical data is very small. In addition, AIC (2189.188), BIC (2227.768), and SABIC (2196.044) values indicate model stability and can be used for comparison if alternative models are available. Overall, these results indicate that the PUM construct measurement model meets the statistical feasibility criteria and is acceptable for further analysis at the latent factor parameter estimation stage.

Estimation of Latent Factor Parameters

After the CFA model was declared to have a good level of conformity, the analysis continued with testing the estimation of latent factor parameters to determine the contribution of each indicator to the construct of PUM. Estimation was carried out by reviewing the loading factor (λ) value, standard error, and z and p-value values to test the significance of the relationship between the indicator and the latent construct. Indicators with *standardized loading factors* above 0.40 are considered to have an adequate contribution in representing the measured construct. The results of the PUM latent factor parameter estimation are shown in full in Table 3 below.

Table 3. Estimation of PUM Latent Factor Parameters

Indicators	**Estimate (λ)**	**Std. Error**	**z-value**	**p-value**	**Std. Loading**	**Interpretation**
PUM1	1,000 (fixed)	—	—	—	0.721	High loading
PUM2	0.697	0.098	7.121	0.000	0.505	Significant
PUM3	0.830	0.104	7.956	0.000	0.606	Significant
PUM4	0.573	0.091	6.270	0.000	0.429	Significant
PUM5	0.669	0.096	6.988	0.000	0.492	Significant

The results of the estimation of latent factor parameters in table 3 show that all indicators that make up the construct of Perception of Independent Business (PUM) have a significant loading factor value. Based on the results of the analysis, all indicators have a p<value of 0.001, which means that the relationship between the latent construct and each indicator is statistically significant. The PUM1 indicator is used as a reference indicator with a fixed estimated value (1,000) and has the highest standardized loading of 0.721, indicating that this indicator is the most powerful in representing the PUM construct. The PUM3 indicator also showed a high contribution with a loading value of 0.606, followed by PUM2 (0.505), PUM5 (0.492), and PUM4 (0.429). All loading factor values are above the minimum limit of 0.40, so it can be concluded that each indicator has an adequate contribution to the latent construct being measured.

Variance and Measurement Error

Furthermore, an analysis of latent construct variance and measurement error was carried out to assess how much the latent variable contributed to each indicator and the proportion of errors that appeared in the model. Construct variance indicates the magnitude of the diversity that can be explained by latent factors, while the error variance indicates the magnitude of the diversity that cannot be explained by the model. A significant estimation value ($p < 0.05$) indicates that both constructs and errors have a significant contribution to the measurement model. Details of the results of the estimated variance and error for the PUM construct are presented in Table 4 below.

Table 4. Variance and Error

Variable	Estimate	Std. Error	z-value	p-value	Std. Var
Var(PUM)	0.125	0.021	6.062	0.000	1.000
e(PUM1)	0.115	0.016	7.333	0.000	0.480
e(PUM2)	0.177	0.016	11.377	0.000	0.745
e(PUM3)	0.148	0.015	9.971	0.000	0.633
e(PUM4)	0.182	0.015	12.027	0.000	0.816
e(PUM5)	0.175	0.015	11.504	0.000	0.758

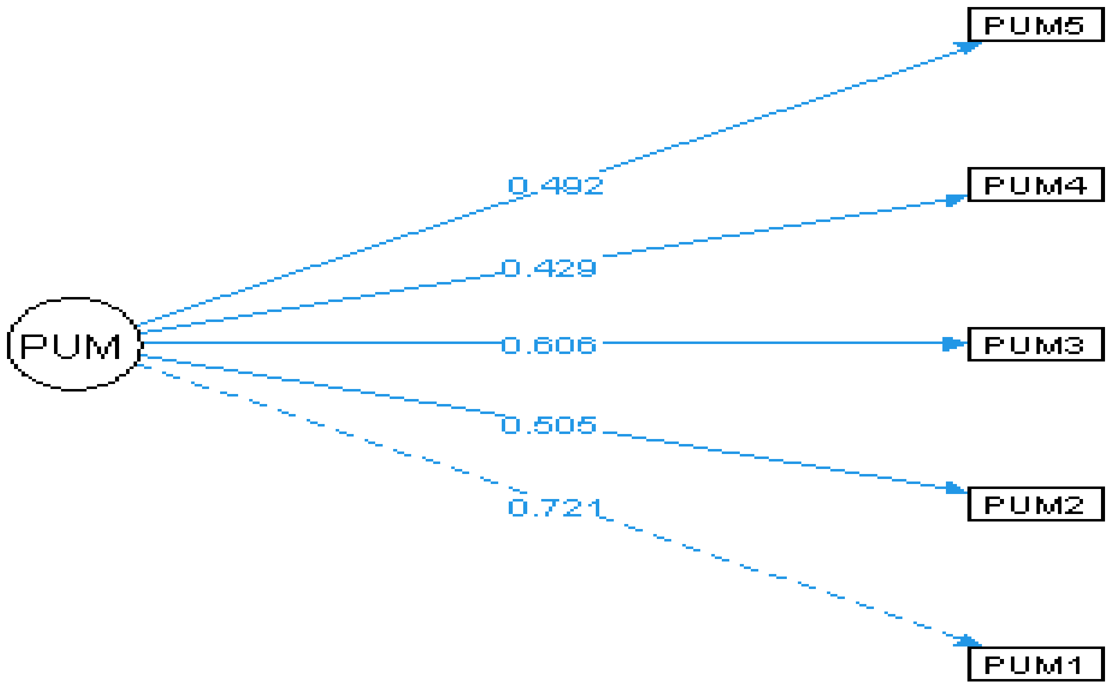

Figure 1. Scree Plot Path Diagram

The analysis of variance and measurement error in table 4 was carried out to assess the contribution of the latent construct of Perception of PUM to the indicators, as well as the extent to which measurement errors (error variance) occurred in each item. Based on the estimation results, the value of the PUM construct variance was 0.125 with $p < 0.001$, which shows that the construct is statistically significant and has a real diversity in explaining the indicator. The measurement error value (e) for each indicator was also significant at the p< level of 0.001, with a range of 0.115 to 0.182. The indicator with the smallest error is PUM1 (0.115), while the largest error is found in PUM4 (0.182). This relatively small error value indicates that most of the variance of the indicator can be explained by latent constructs.

The visualization of the CFA measurement model in Figure 1 shows that each indicator has a one-way arrow direction from the PUM latent construct to the individual indicator (PUM1–PUM5), with standardized loading values ranging from 0.429 to 0.721. This model shows a positive relationship between the latent construct and all its indicators, and confirms that there is no cross-loading relationship between the indicators. Thus, the model can be said to be stable and statistically well measured.

Coefficient of Determination (R-Square)

As a final step in the CFA analysis, the value of the determination coefficient (R^2) for each indicator is calculated in the Perception of PUM construct. The value of R^2 indicates the proportion of variance in the indicator that can be explained by latent constructs. The higher the R^2 value, the stronger the indicator is in representing the measured construct. Thus, this value is the basis for assessing the reliability of each indicator in explaining the latent variable of PUM. The results of the calculation of the R-square value for all indicators are presented in Table 5 below.

Table 5**.** R-Square Value (Coefficient of Determination)

Indicators	**R^2**	**Interpretation**
PUM1	0.520	52% variance explained construct
PUM2	0.255	25.5% variance explained construct
PUM3	0.367	36.7% variance explained construct
PUM4	0.184	18.4% variance explained construct
PUM5	0.242	24.2% variance explained construct

The results of the calculation of the R-Square value (R^2) in table 5 show the large proportion of variance in each indicator which can be explained by the latent construct of PUM. Based on the results of the analysis, the R^2 values for the five indicators ranged from 0.184 to 0.520, with an average of 0.314. The PUM1 indicator has the highest R^2 value of 0.520, which means that 52% of the variance of the indicator is explained by the PUM construct. It was followed by PUM3 (0.367), PUM2 (0.255), PUM5 (0.242), and PUM4 (0.184). These values show that all indicators have a positive contribution in explaining latent construct variance albeit to varying degrees.

DISCUSSION

CFA Model Summary

The findings at the estimation stage show that the PUM construct measurement model has good technical characteristics. The use of the Maximum Likelihood (ML) method is in accordance with the recommendations (Hubona et al., 2021), stating that ML is the most common and efficient method in CFA because it is able to generate estimates with minimum variance and low bias. In addition, this method allows simultaneous testing between indicators in a single, integrated model. The success of the model achieving convergence in 28 iterations indicates that the model structure is well identified and the estimation parameters have reached stability. This reflects that the relationship between latent constructs and their indicators has been empirically consistent and does not cause serious measurement errors. The rapid convergence process also shows that the NLMINB algorithm works effectively in optimizing the log-likelihood value of the model.

The number of 350 respondents is considered very adequate to support the accuracy of parameter estimation. According to Byrne (2010), a large sample size can increase the reliability of the CFA model and reduce estimation errors due to data variations. With the fulfillment of the requirements for sample adequacy and model stability, these results provide a strong basis that the Perception of Independent Business (PUM) construct model is feasible to proceed to the evaluation stage of the model suitability index.

Model Fit

The findings of the model suitability test show that the PUM construct model has a very good level of compatibility with empirical data. An insignificant Chi-square value ($p > 0.05$) indicates that the proposed theoretical model does not differ significantly from the actual data, so that this model can be accepted as a valid representation of the measured construct (Hair et al., 2020). The values of CFI = 0.979 and TLI = 0.958 reinforce the evidence that the model has a high incremental fit, which means that the CFA model tested provides a significant improvement in fit compared to the baseline model (null model). These results show that the relationship between the latent construct and its indicators is consistent with the underlying theory, as well as showing good measurement quality.

In addition, the values of RMSEA = 0.054 and SRMR = 0.029 which are within the ideal fit range (< 0.08) indicate that the estimation error in the model is very small. This index reflects that the difference between the estimated and observed covariance matrices is very minimal, so the proposed model structure is statistically reliable. The value $\chi^2/df = 2.039$ which is below threshold 3 also indicates that the complexity of the model is still acceptable without compromising the suitability of the data. This signifies a balance between parsimony (simplicity of the model) and the accuracy of the model in explaining the relationships between variables.

Estimation of Latent Factor Parameters

The results of the latent factor parameter estimation confirm that all indicators have a significant and positive relationship to the PUM construct, which indicates that the measurement model has good convergent validity. According to Hair et al., (2020), a standardized loading value above 0.40 is considered sufficient to state that an indicator can represent the construct being measured, while a value above 0.70 indicates a very strong indicator. In this study, the PUM1 indicator with a loading value of 0.721 was the most dominant measure, indicating that the aspect it represents plays an important role in shaping the perception of independent business. Meanwhile, indicators with lower loading values, such as PUM4 (0.429) and PUM5 (0.492), although relatively smaller, remained significant and met the minimum criteria. This shows that these indicators remain relevant, even if their contribution is not as strong as the main indicators.

The sequencing of the loading factor value also reflects the difference in the strength of each indicator's contribution to the PUM construct, which conceptually illustrates that the dimension of self-employed perception is a multidimensional construct. This means that each indicator captures different but complementary aspects in explaining individual perceptions of the ability and drive to be self-employed. With all the value of the loading factor significant ($p < 0.001$) and above the minimum limit of 0.40, these results confirm that the PUM construct measurement model has strong construct validity and is able to represent the underlying theoretical concept empirically.

Variance and Measurement Error

The results of the estimation of variance and error in Table 4 show that the PUM construct measurement model has good measurement quality with a low error rate. The construct variance of 0.125 indicates that the latent factor of PUM has sufficient diversity in explaining the differences between respondents to the measured indicators. This shows that the PUM construct is a real psychological dimension and can be distinguished between individuals.

The relatively small measurement error value (0.115–0.182) indicates that the proportion of variance not explained by the latent construct is quite low. The smaller the error, the higher the reliability of the indicator in representing the construct Retnawati, (2014). The PUM1 indicator which has the lowest error value (0.115) reinforces the previous finding that this indicator is the most powerful gauge in the PUM construct, in line with the highest loading factor result (0.721). In contrast, the PUM4 indicator with the highest error (0.182) although significant, suggests that some of its variance is still influenced by factors outside the main construct.

The CFA model image shows a simple and clear relationship pattern, where all the arrows from the PUM construct to its indicators are positive. This proves that all indicators move in the same direction in explaining latent constructs, without any cross-loading or residual correlation disruption between indicators.

Coefficient of Determination (R-Square)

The value of the determination coefficient (R^2) obtained indicates the level of consistency of the relationship between the latent construct of PUM and its measuring indicators. Based on the criteria presented by the Heri Retnawati, (2016), an R^2 value above 0.25 indicates moderate relationship strength, while a value above 0.50 indicates strong strength. In this study, the PUM1 indicator was relatively strong because it was able to explain more than half of its variance (52%) through the PUM construct.

Other indicators such as PUM2, PUM3, PUM4, and PUM5 are in the moderate to low category. The lowest R^2 value is found in PUM4 (0.184), which means that only about 18.4% of the variance is explained by latent constructs. Nevertheless, all indicators still contribute significantly in explaining the construct, according to the results of the previous loading factor which showed significance at the level of $p < 0.001$.

The difference in R^2 values between these indicators illustrates that the Perception of Independent Business (PUM) construct is multidimensional, where each indicator captures different but complementary aspects. Indicators with higher R^2 values show stronger dimensions and are more consistent in explaining the main construct, while indicators with lower R^2 values remain important as complements that enrich the overall meaning of the construct.

CONCLUSIONS AND RECOMMENDATIONS

This study proves that the construct model of Perception of PUM has good validity and model suitability based on the results of Confirmatory Factor Analysis (CFA) analysis. All indicators show a significant contribution to the measured construct, so this instrument is considered to be able to accurately and consistently represent the perception of business independence. In addition, the findings of the study indicate that PUM instruments can be used as a reliable measurement tool in the context of learning or training that emphasizes the development of business independence. Thus, this instrument has the potential to be a reference in the evaluation of entrepreneurship education or similar research in the social and educational fields.

Further research is suggested to expand the number and diversity of samples to test measurement invariance between groups of respondents and to strengthen the generalization of results. In addition, it is necessary to conduct structural model analysis (SEM) and longitudinal testing to assess the relationship between constructs and the stability of instruments over time, so that the results of the research can provide a deeper and more applicable understanding in various educational and social contexts.

ADVANCED RESEARCH

Further research is suggested to expand the testing of the model to involve a more diverse sample, both in terms of region, education level, and participant background, in order to test measurement invariance and strengthen the generalization of results. Further analysis can also be done by adding structural models (SEM) to see the relationships between more complex constructs, such as the influence of perception of independent effort on motivation and learning performance. In addition, it is necessary to carry out long-term (longitudinal) reliability testing to ensure the stability of the construct over time. This approach is expected to provide a deeper understanding of the validity and consistency of instruments in various educational and social contexts.

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