



Uncovering the Relationships among Entrepreneurial Competency Variables in University Students: A CFA Approach

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Abstract

Entrepreneurship has a crucial role in creating jobs and triggering economic development. Furthermore, entrepreneurship offers a solution to social problems and the oversupply of university graduates. Therefore, entrepreneurship is essential for students, including science students. This study seeks to uncover the relationships among the variables of entrepreneurial competencies, consisting of knowledge, skills, and attitudes. The study design was a cross-sectional survey conducted from January to June 2024. The sampling technique was carried out by purposive sampling involving 346 science undergraduate students as research samples. The instrument used in this study was a questionnaire consisting of 15 statements of knowledge competency aspects, 16 statements of skill competency aspects, and 21 statements of entrepreneurial attitude competency aspects. This study employed Confirmatory Factor Analysis as the data analysis technique, conducted using AMOS software. The analysis results demonstrated that there was a very close and positive correlation in each variable of entrepreneurial competency. Knowledge competency was found to be positively related to skill competency (correlation coefficient of 0.817), knowledge competency was positively correlated with attitude competency (correlation coefficient of 0.870), and skill competency was positively correlated with attitude competency (correlation coefficient of 0.955). Each indicator provided a varying contribution in explaining aspects of entrepreneurial competency as indicated by the coefficient of determination (R^2).

Keywords: Attitude Competency; Entrepreneurial Competencies; Knowledge Competency; Science Students; Skill Competency.

Introduction

Entrepreneurship is one of the competencies needed in the 21st century. Entrepreneurship has been shown to make a major contribution to job creation, innovation and economic growth, and sustainable development (Aparicio et al., 2015; Hermanto & Suryanto, 2017; Meyer & Meyer, 2017). Various studies provide empirical evidence of the importance of knowledge-based entrepreneurship in achieving higher economic growth (Aparicio et al., 2015). Furthermore, Ambad & Damit (2016) also explained that entrepreneurship plays a vital role in providing solutions to the excess number of university graduates and social problems. The role of entrepreneurship is increasingly evident, both in developed and developing countries that often face various socio-economic challenges (Meyer & Meyer, 2017).

In Indonesia, entrepreneurship is a key focus for the government in its efforts to prepare students to become resilient graduates who are relevant to the needs of the times. Entrepreneurship is now part of the higher education curriculum. The government, through the Minister of Education and Culture, launched the Independent Learning Campus (MBKM) curriculum. Education serves as a vehicle for fostering entrepreneurship. Similar statements were made by Afzal et al. (2018); Pal'ová et al. (2020) who stated that educational institutions play a key role in empowering entrepreneurship. Entrepreneurship education produces independent graduates who can utilize the skills they acquire to build their own businesses (Ejilibe, 2012). Furthermore, Shahiwala (2017) said that entrepreneurship education is very important in shaping the mindset of the younger generation, opening up job opportunities, and improving the economy.

The importance of entrepreneurship development is also driven by the low entrepreneurship index in Indonesia, according to data from the Global Entrepreneurship Index (GEI) in 2019. The study results showed that Indonesia only had a score of 26 entrepreneurs from various fields, or ranked 75th out of 137 countries surveyed (Ács et al., 2019). Meanwhile, according to research by the IDN Research Institute in 2019, it was reported that 69.1% of millennials in Indonesia were interested in entrepreneurship. Furthermore, the facts also show that in Indonesia there is a gap between the population size and the number of existing entrepreneurs. Data from the Central Statistics Agency (BPS) in 2022 shows that the number of productive-age residents (15-64 years) is greater than the number of young people (0-14 years) and the elderly (65 years and over). Furthermore, the same source also explained that the labor force participation rate was 67.8% and the open unemployment rate reached 6.5% (BPS, 2022).

In a global era marked by rapid technological advancements, undergraduate students are required to possess competencies that will better prepare them for the highly dynamic world of work. These competencies are entrepreneurial competencies. Entrepreneurial competencies encompass knowledge, skills, and attitudes (Al Mamun et al., 2017). With entrepreneurial competencies,

undergraduate students have a greater opportunity to create jobs, not just find them. Science undergraduate students have a significant opportunity to develop entrepreneurial competencies because scientific fields have the potential to become entrepreneurial objects, for example, biotechnology (Ejilibe, 2012; Liu et al., 2022).

Various studies related to entrepreneurship involve varied research topics and allow for the creation of new theories, thus opening up interesting research opportunities. Furthermore, it is stated that entrepreneurship is a topic that will always be a focus in research (Ratten, 2022). Research by Al Mamun et al. (2017) explains the development of an instrument for measuring entrepreneurial knowledge and skills. Another study was conducted by Ibrahim et al. (2018) regarding the development of an entrepreneurship index. Research by Hermanto & Suryanto (2017) explains the policy of the entrepreneurial ecosystem in Indonesia. Ambad & Damit (2016); Haque et al. (2017) conducted research that revealed the determinants of entrepreneurial intentions among students. Furthermore, the urgency of entrepreneurial skills and competencies in the 21st century in higher education is also explained in research by Ghafar (2020); Pattanayak & Padhy (2020).

In light of the above explanation concerning the significance of entrepreneurial competence, especially for students, further research is needed regarding entrepreneurial competencies. Unlike previous study, the study concentrates on uncovering the relationship between each variable of entrepreneurial competency in science undergraduate students, including knowledge, skills, and attitudes. It also explores the contribution of each indicator to each of these three competencies.

Research Methodology

A cross-sectional survey approach was adopted in this study (Creswell & Guetterman, 2019) conducted from January to June 2024. Survey design is crucial for research using large sample sizes so that findings can be generalized to the population effectively and accurately (Bahri et al., 2014). The objective of this study was to identify the correlation between variables of entrepreneurial competencies and reveal the magnitude of the contribution of each indicator of the three aspects of entrepreneurial competencies.

This study employed purposive sampling as the sampling technique, which utilizes specific considerations in accordance these research objectives. This research included science undergraduate students from biology study program, biology education study program, and science education study program from 17 universities in Indonesia. The sample consisted of 346 students who had taken courses in entrepreneurship and biotechnology.

The research instrument was a questionnaire containing 52 statements consisting of 15 statements on the knowledge variable, 16 statements on the skills variable, and 21 statements on the attitude variable related to entrepreneurial competencies. The knowledge competency consists of Self-

knowledge (SK) and Entrepreneurial knowledge (EK) indicators. The skills competency consists of Planning for the future (PF), Results-oriented (RO), Learning orientation (LO), and Independence (ID) indicators. The attitude competency consists of Building networks (BN), Risk-taking (RT), and seeing opportunities (SO) indicators. The questionnaire was packaged in a Google form and given to respondents via WhatsApp. The reason for using the WhatsApp application was that respondents were already accustomed to using it in daily communication, so it was expected to be easier in obtaining data and related to time efficiency.

The questionnaire used was a modification of a questionnaire developed by several previous researchers (Al Mamun et al., 2017; Dalyanto et al., 2021) has been tested for validity and reliability. Results obtained from the validity testing employing the Product Moment correlation showed $>$ the r table (0.103), which means the questionnaire meets the validity criteria. The results of the reliability test showed that the value of Cronbach's alpha for each indicator $>$ 0.6, so it was concluded that the questionnaire met the reliability criteria.

This study employs Confirmatory Factor Analysis as its data analysis method. The data analyzed in the CFA method is Covariances Based Data (CBD). The data processing process uses Amos software. The test steps taken are compiling a CFA model image and continuing to test the suitability of the measurement model (goodness of fits). The criteria that the measurement model is appropriate are if Sig. Probability Chi Square $>$ 0.05; RMSEA value \leq 0.08; SRMR value \leq 0.1; NFI value, CFI value, GFI value, and AGFI value \geq 0.9 (Arbuckle, 2005; Schermelleh-Engel et al., 2003).

The subsequent step involves testing the measurement model using construct validity and reliability tests. A statement item is declared valid if the factor loading and AVE values $>$ 0.7. The factor variable is deemed reliable provided that the AVE value is above 0.5 and the CR value exceeds 0.6 (Arbuckle, 2005; Schermelleh-Engel et al., 2003). The final step is to analyze the correlation between knowledge, skills, and attitudes and then evaluate the coefficient of determination (R^2).

Findings and Discussion

Findings

Data analysis using the Confirmatory Factor Analysis (CFA) method produced a CFA model containing the relationships between aspects of entrepreneurial competencies as presented in Figure 1. Furthermore, the description of the symbols in the CFA model is explained in Table 1.

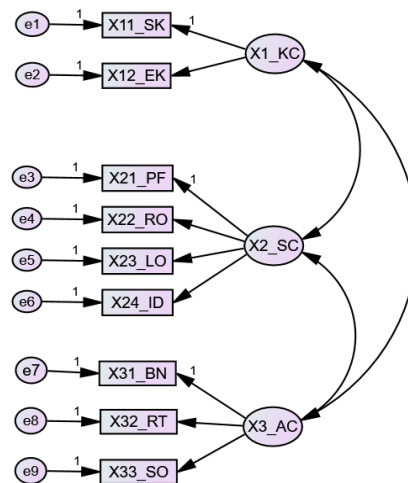


Figure 1. CFA Model: Correlation of Aspects of Entrepreneurial Competencies
Table 1. Description of symbols in the CFA correlation model of entrepreneurial competencies aspects

Factor Variables (Constructs)	Indicator Variables	Error Variables
Knowledge Competency (X1_KC)	X11_SK (Self-knowledge)	e1
	X12_EK (Entrepreneurial knowledge)	e2
Skill Competency (X2_SC)	X21_PF (Planning for the future)	e3
	X22_RO (Results-oriented)	e4
	X23_LO (Learning orientation)	e5
	X24_ID (Independence)	e6
Attitude Competency (X3_AC)	X31_BN (Building networks)	e7
	X32_RT (Risk-taking)	e8
	X33_SO (Seeing opportunities)	e9

Findings from the CFA model assessment reveal that the Goodness of Fits value meets the criteria for good model suitability, such as the Sig. Probability Chi Square value > 0.05; the RMSEA value ≤ 0.08; the NFI value, the CFI value, the GFI value, and the AGFI value ≥ 0.9. For additional details, Table 2 reports the goodness-of-fit values of the CFA model.

Table 2. Goodness of Fits value of CFA correlation model of entrepreneurial competencies aspects

SEM	χ^2	P	RMSEA	NFI	CFI	GFI	AGFI
Model Fit Value	24.983	.248	.023	.988	.998	.984	.966

Next, the fit CFA model becomes the final CFA model. The estimated results from this final model are then used to test the measurement model using validity, reliability, and correlation tests. The following visualization of the final model, containing standardized estimated values, is presented in Figure 2.

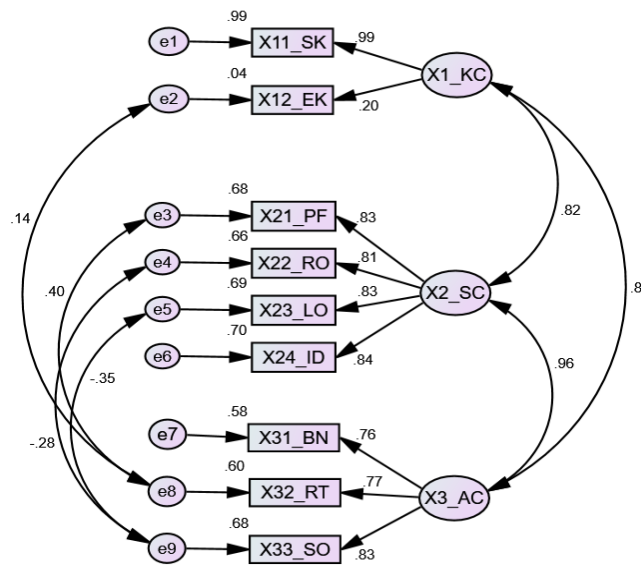


Figure 2. Final CFA model: standardized estimates values

The results of the validity and reliability tests in the measurement model can be seen in Table 3 below.

Table 3. Results of validity and reliability testing

Factors	Indicators	Validity Test				Reliability Test		
		Standardized	Weights	P-values	Conclusion	Average Variance Extracted (AVE)	Composite Reliability (CR)	Conclusion
Knowledge Competency (X1_KC)	X11_SK (Self-knowledge)	0.993	1	Fix parameter	Valid	0.51	0.6	Reliable
	X12_EK (Entrepreneurial knowledge)	0.196	1.068	0.00	Valid			
Skill Competency (X2_SC)	X21_PF (Planning for the future)	0.826	1	Fix parameter	Valid	0.68	0.90	Reliable
	X22_RO (Results-oriented)	0.812	1.168	0.00	Valid			
	X23_LO (Learning orientation)	0.83	0.736	0.00	Valid			
	X24_ID (Independence)	0.839	0.979	0.00	Valid			
Attitude Competency (X3_AC)	X31_BN (Building networks)	0.763	1	Fix parameter	Valid	0.62	0.83	Reliable
	X32_RT (Risk-taking)	0.774	0.391	0.00	Valid			
	X33_SO (Seeing opportunities)	0.826	1.182	0.00	Valid			

Table 3 shows that factor loadings range from 0.196 to 0.90, with all p-values equal to 0.00 (< 0.05), indicating that all indicators and constructs in the CFA model are valid. Furthermore, the reliability analysis reveals AVE values between 0.50 and 0.68 and CR values ranging from 0.60 to 0.90, all of which meet the minimum thresholds, confirming that the constructs in the CFA model are reliable

Subsequently, Table 4 presents the results of the correlation tests among the factor variables in the final CFA model.

Table 4. Results of correlation tests between factor variables in the CFA entrepreneurial competencies model

Hypothesis	Relation	Factor Variables	Indicators	Correlation estimate	Covariance estimate	P-value	Conclusion
H1	Correlation	Knowledge Competency (X1_KC)	Skill Competency (X2_SC)	.817	4.926	0.00	Significant
H2	Correlation	Knowledge Competency (X1_KC)	Attitude Competency (X3_AC)	.870	10.745	0.00	Significant
H3	Correlation	Skill Competency (X2_SC)	Attitude Competency (X3_AC)	.955	9.450	0.00	Significant

Based on Table 4, the correlation value between the factor variables is 0.817–0.955, thus concluding that the three factor variables have a very close and positive correlation. This means that the relationship between the two factor variables is in the same direction. The contribution of each indicator variable to the factor variable is indicated by the coefficient of determination (R^2), as described in Table 5.

Table 5. Value of coefficient of determination (R^2) and regression equation

Number	Regression Equation (Standardized Coefficients)	R^2
1	Knowledge Competency (X1_KC) = 0.993 X11_SK (Self-knowledge)	0.987
2	Knowledge Competency (X1_KC) = 0.196 X12_EK (Entrepreneurial knowledge)	0.039
3	Skill Competency (X2_SC) = 0.826 X21_PF (Planning for the future)	0.683
4	Skill Competency (X2_SC) = 0.812 X22_RO (Results-oriented)	0.659
5	Skill Competency (X2_SC) = 0.830 X23_LO (Learning orientation)	0.689
6	Skill Competency (X2_SC) = 0.839 X24_ID (Independence)	0.704
7	Attitude Competency (X3_AC) = 0.763 X31_BN (Building networks)	0.582
8	Attitude Competency (X3_AC) = 0.774 X32_RT (Risk-taking)	0.599
9	Attitude Competency (X3_AC) = 0.826 X33_SO (Seeing opportunities)	0.682

Table 5 shows that the Self-knowledge indicator has a very strong influence on Knowledge Competency ($\beta = 0.993$; $R^2 = 0.987$), indicating that 99% of the variance in Knowledge Competency

is explained by this indicator. In contrast, Entrepreneurial Knowledge exhibits a weak contribution to Knowledge Competency ($\beta = 0.196$; $R^2 = 0.039$), accounting for only 4% of the variance. For Skill Competency, Planning for the Future ($\beta = 0.826$; $R^2 = 0.683$), Results-oriented ($\beta = 0.812$; $R^2 = 0.659$), Independence ($\beta = 0.839$; $R^2 = 0.704$), and Learning Orientation ($\beta = 0.830$; $R^2 = 0.689$) all demonstrate substantial explanatory power, contributing between 66% and 70% of the variance in Skill Competency. Regarding Attitude Competency, Building Networks ($\beta = 0.763$; $R^2 = 0.582$) and Risk-taking ($\beta = 0.774$; $R^2 = 0.599$) show moderate contributions, while Seeing Opportunities ($\beta = 0.826$; $R^2 = 0.682$) provides a substantial contribution, explaining 68.2% of the variance. Overall, the remaining unexplained variance across indicators is attributable to factors outside the model.

Discussion

Results of the data analysis demonstrate that Knowledge, Skill, and Attitude Competencies are significantly correlated. This finding is in line with the findings Tehseen & Ramayah (2015) that entrepreneurial competence is correlated with a manager's knowledge, skills, and abilities. The Knowledge Competency is closely and positively correlated with the Skill Competency with a correlation value of 0.817. Knowledge is the basic foundation for someone to be able to apply their understanding of entrepreneurship. Entrepreneurial knowledge directs entrepreneurial skills that include technical and practical abilities in running a business. During practice in the field, skills will test the extent to which knowledge can be applied, and often generate new knowledge from field experiences. The abilities possessed by an entrepreneur in the form of knowledge, valuable capabilities, and skills can improve the performance of his company, as explained by Al Mamun et al. (2019); Tehseen & Ramayah (2015). It is further stated that to be able to develop entrepreneurial competence, a person is required to have the skills to face the challenges of starting a project (Al Mamun et al., 2019). The positive correlation between the Knowledge Competency and the Skill Competency explains that the higher a person's entrepreneurial knowledge, the greater the chance of that person having good entrepreneurial skills.

This finding explains the positive correlation between Knowledge Competency and Attitude Competency, as indicated by a correlation value of 0.870. This can be further explained by the fact that the more knowledge a person possesses, the more likely they are to have a positive attitude toward entrepreneurship. Individuals with good entrepreneurial knowledge tend to be more optimistic, innovative, and courageous in starting a business. Ratten (2022) explains that entrepreneurship encompasses not only positive activities but also negative contexts because the methods used encourage risk-taking. The positive correlation between Knowledge Competency and Attitude Competency can explain that knowledge provides a rational basis, while attitude provides the mental impetus for action.

The finding also revealed a positive correlation between Skill Competency and Attitude Competency, as indicated by a correlation value of 0.955. This can be explained by the fact that a positive attitude makes someone consistently practice skills, and honed skills increase one's self-confidence, which is part of attitude. Moreover, individuals with strong skills tend to be more optimistic and confident in seizing opportunities. The present finding is in line with the findings of Shabbir (2025) which explains that attitude significantly moderates the impact of skills on entrepreneurial intentions. This means that cultivating a positive attitude and relevant skills can increase one's capacity for entrepreneurship.

Based on the coefficient of determination (R^2), this finding also explains that the most influential indicator on Knowledge Competency is Self-knowledge with a contribution of 99%; the most influential indicator on Skill Competency is Independence with a contribution of 70.4%; and the most influential indicator on Attitude Competency is Seeing Opportunities with a contribution of 68.2%.

Conclusion and Suggestion

These findings explain that each variable of entrepreneurial competency, which includes knowledge, skills, and attitude competencies, has a close correlation with each other. The knowledge competency is positively correlated with skill competency and attitude competency with correlation values of 0.817 and 0.870. Skill competency is positively correlated with attitude competency with a value of 0.955. These findings are expected to be used as a reference in developing entrepreneurial competencies in students, not only science undergraduate students. Through the application of various learning models and methods in the classroom, educators are expected to be able to develop every variable of entrepreneurial competencies in students because each variable is positively correlated.

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