

The Role of Academic Self-Efficacy and Mindset on Academic Grit among Civil Engineering Students

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Abstract. This research aimed to empirically examine the role of academic self-efficacy and mindset on grit in civil engineering students. Grit is the persistence required by students in academic field to complete school, specifically at the stage of final project. A quantitative method was used with a correlational design to analyze 335 final year students of civil engineering program selected through proportional random sampling. Data analysis was carried out using Structural Equation Modeling-Partial Least Squares (SEM-PLS) method. The results showed that academic mindset and self-efficacy had a significant effect on grit with a contribution of 26.2%, while the remaining 73.8% was influenced by other factors. This research reported the importance of psychological factors, such as mindset and self-efficacy, in increasing persistence to compete long-term academic tasks.

Keywords: *Academic Grit, Academic Self Efficacy, Civil Engineering Students, Mindset, Structural Equation Models.*

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Introduction

Academic grit, or perseverance, is essential for students, specifically in completing final assignments to address challenges such as procrastination and giving up easily, which often lead to delayed graduations. According to Higher Educational Statistics (Handini et al., 2020), 40% of students in Yogyakarta dropped out due to low perseverance and learning motivation. Grit is characterized by determination and resilience, playing a significant role in reducing negative academic behaviors and improving performance (Perkins-Gough & Duckworth, 2013). Research shows that grit, mindset, self-efficacy, and motivation, enhance students' ability to achieve long-term academic goals despite challenges, transforming talent into actionable skills through sustained effort (Credé et al., 2017; Mohd Matore et al., 2020; Martin et al., 2022; Papalia et al., 2014). Grit influences success more than talent, hence, perseverance becomes an important factor of success when comparing individuals with the same talent (Perkins-Gough & Duckworth, 2013). Talent is an untapped potential without grit, and this skill leads to success (Papalia et al., 2014).

Academic grit, defined as determination, resilience, and focus in achieving long-term academic goals, is influenced by mindset, self-efficacy, learning motivation, and parenting style (Clark & Malecki, 2019; Ghaybiyyah, 2021). Academic self-efficacy, or the belief in the ability to succeed, promotes resilience and persistence, helping students overcome challenges and achieve better outcomes (Honicke & Broadbent, 2016; Sagone & Caroli, 2014). A positive mindset is characterized by the belief that abilities can be developed through effort and complements self-efficacy in improving growth and success (Dweck, 2006; Limeri et al., 2020). Research shows the interconnected and distinct roles of these traits since students with high self-efficacy and a positive mindset are more confident, motivated, and able to navigate obstacles. Meanwhile, students with low self-efficacy often struggle with confidence and task completion (Barbouta et al., 2020; Glerum et al., 2020; Muarifah & Nurliyana, 2022; Zander et al., 2018).

This research presents a scientific novelty by examining the role of academic self-efficacy and mindset simultaneously on grit in final-year civil engineering students in Indonesia. Most previous

research examined individual variables separately or in general student populations (Alhadabi & Karpinski, 2020; Barbouta et al., 2020). Measuring tools are used based on relevant theories (Clark & Malecki, 2019; Dweck, 2006; Sagone & Caroli, 2014), and validated through Structural Equation Modeling–Partial Least Squares (SEM-PLS), contributing to a robust quantitative analysis method rarely used in educational psychology research. The results showed that academic mindset and self-efficacy contributed 26.2% to academic grit. Therefore, psychological factors play a significant role in academic resilience, particularly in completing final projects.

In comparison to recent research, the limitations of previous results include the lack of focus on final-semester students facing significant academic pressures, such as completing final assignments. Additionally, previous research did not sufficiently address the intersection of academic self-efficacy and mindset as influencing factors for grit. These gaps provide a compelling rationale to investigate the influence of academic self-efficacy and mindset on grit in civil engineering students. The major hypothesis states that there is a role of mindset and academic self-efficacy in grit. The minor hypotheses include a) There is a positive role of academic self-efficacy and grit, and b) There is a positive role of mindset and academic grit.

The variables considered include Academic grit (Y), Academic Self-Efficacy (X1), and Mindset (X2). Figure 1 shows the theoretical framework proposed in this research.

Methods

This research uses a quantitative method with a correlational design to empirically examine the role of academic self-efficacy and mindset on grit in civil engineering students. The subject is final-year students of Civil Engineering Study Program from several universities in Indonesia, with a population of approximately 2,000 students pursuing a thesis or final project. The sample amounted to 335 students, determined using proportional random sampling, and the number was obtained based on the opinion of Hair et al., (2014). The minimum number of samples in SEM-PLS-based research is 10 times the number of indicators in the measurement model.

The instruments consisted of three psychological scales, namely academic grit scale, self-efficacy, and mindset. Grit scale was developed based on aspects from Clark and Malecki (2019), namely determination, resilience, and focus, consisting of 18 items with a 5-point Likert scale model (1 = very inappropriate to 5 = very appropriate). An example of item include "I still complete a task despite having difficulties." Academic self-efficacy scale is compiled based on aspects from Sagone and Caroli (2014), namely self-engagement,

independent decision-making, other-oriented problem-solving, and interpersonal climate, consisting of 25 items using a 5-point Likert scale. A typical example item includes "I am confident that I can complete my assignment on time." Mindset scale was developed from the concept of Dweck (2006), including paradigms, core beliefs, and values with 24 items. An example item includes "I believe my abilities can develop through practice."

All instruments are subjected through an initial trial process with 50 respondents who are not part of the main sample, to ensure the validity and reliability of the measurement. The results of the validity test showed that the loading factor value ranged from .708 to .983. The reliability results reported that Cronbach's alpha and composite reliability values were adequate above .7 since the entire scale was feasible for use.

Data collection was carried out online using a Google Form shared with respondents through lecture groups, emails, and social media. Before filling out the questionnaire, the purpose of the research was explained and respondents were asked to fill in informed consent. This research received an ethics permit from the Research Ethics Commission of Ahmad Dahlan University with the number 012409310.

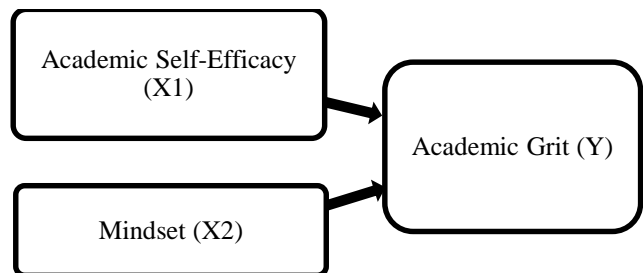


Figure 1. Theoretical Framework

Results and Discussion

Result

The results show the role of academic self-efficacy and mindset toward grit in civil engineering students. Appendix shows the correlation model of variables.

The model was tested using convergent and discriminatory validity, with the criteria of loading factor (λ) $.7 \geq$ and Average Variance Extracted (AVE) $>.5$ (Ghozali & Latan, 2015; Hair et al., 2014). The value of loading factor of each variable can be seen in Table 1. Table 1 shows that all indicators on academic grit scale have a value λ of $>.7$ indicates all items are valid.

Table 2 shows that all indicators on academic self-efficacy scale have a value λ of $>.7$ since existing indicators can be declared valid. The indicators on mindset scale have a value λ of $>.7$ and can be declared valid. Therefore, the convergent validity of the

measurement instruments used is valid and meets the criteria for convergent validity.

Discriminant validity testing shows that measurements of different constructs should not have high correlations. The discriminant validity measurement test is assessed by examining the cross-loadings of the constructs. Fornell and Larcker state that each indicator is considered to explain the variable compared to others when the cross-loadings between the indicators and latent variable are greater than the cross-loadings (Ghozali & Latan, 2015).

Table 1
Convergent Validity of Academic Grit (AG)

	AG	Valid
Y1	.803	Valid
Y10	.883	Valid
Y11	.815	Valid
Y12	.878	Valid
Y13	.795	Valid
Y14	.815	Valid
Y15	.727	Valid
Y16	.817	Valid
Y17	.877	Valid
Y18	.859	Valid
Y2	.796	Valid
Y3	.816	Valid
Y4	.883	Valid
Y5	.812	Valid
Y6	.815	Valid
Y7	.823	Valid
Y8	.738	Valid
Y9	.818	Valid

Table 2
Convergent Validity of Academic Self-Efficacy (ASE)

	ASE	Valid
X1.1	.978	Valid
X1.10	.983	Valid
X1.11	.973	Valid
X1.12	.978	Valid
X1.13	.981	Valid
X1.14	.863	Valid
X1.15	.971	Valid
X1.16	.972	Valid
X1.17	.981	Valid
X1.18	.972	Valid
X1.19	.979	Valid
X1.2	.983	Valid
X1.20	.982	Valid
X1.21	.830	Valid
X1.22	.980	Valid
X1.23	.911	Valid
X1.24	.975	Valid
X1.25	.917	Valid
X1.3	.982	Valid
X1.4	.981	Valid
X1.5	.980	Valid
X1.6	.982	Valid
X1.7	.974	Valid
X1.8	.978	Valid
X1.9	.958	Valid

Based on Table 4, the variables of grit, academic self-efficacy, and mindset have AVE value of $>.5$. This shows that the indicator of each variable is discriminatory.

Reliability testing is conducted to measure the internal consistency of the measurement instrument. In SEM-PLS, the testing can use Cronbach's alpha and composite reliability. Cronbach's alpha is a lower-bound measure of reliability. Composite reliability measures the actual reliability of a construct. The rule of thumb for Cronbach's alpha and composite reliability is greater than .5 and .6, respectively. In this exploratory research, Cronbach's alpha and composite reliability values ranging from .6 to .7 are acceptable (Ghozali & Latan, 2015). The results of the reliability test are obtained by examining the composite reliability values presented in Table 5.

The composite reliability and Cronbach alpha value for each latent variable analyzed meet the test criteria. Academic grit, self-efficacy, and mindset have Cronbach's alpha of .972, .997, and .976, as well as composite reliability of .974, .998, and .979, respectively. This shows that the three variables can be declared consistent and reliable.

After the testing is considered valid and reliable, the evaluation of the structural model is carried out. In this evaluation, the results of the path coefficient test, the Goodness of Fit test, and the hypothesis test were reported (Muhson, 2022). To obtain the evaluation values, analysis is carried out using a bootstrapping facility on the Smart-PLS 3.0 program. The path coefficient test serves to determine the magnitude of the independent variable on the bound variable (Muhson, 2022).

Based on Table 6, the path coefficient values of ASE and GM for AG are .018 and .000, respectively. This value shows that the greater the path coefficient value, the stronger the influence of the independent variable on the dependent. Furthermore, the structural model test was carried out by analyzing the results of the goodness of fit test based on the determination coefficient of R^2 , with R^2 value obtained from the output of SmartPLS 3.

According to Chin (Ghozali & Latan, 2015), the rule of thumb for model fit is classified as "good", "moderate", and "weak" when R^2 is $>.67$, between .2-.3, and $<.19$, respectively. Based on the analysis results, R^2 value obtained is .262. Therefore, the fit indicates a moderate model, where AG is influenced by 26.2% ASE and GM.

The test is to analyze the initial hypothesis or initial conjecture based on the bootstrapping output (Henseler et al., 2016). The hypothesis is accepted when the t-statistic value is $>$ the t-table value. In this research, the significance level (2-tailed) is 5%, with a t-table value of 1.96.

Table 3
Konvergen Validity of Mindset (GM)

	GM	Valid
X2.1	.891	Valid
X2.10	.708	Valid
X2.11	.858	Valid
X2.12	.755	Valid
X2.13	.761	Valid
X2.14	.838	Valid
X2.15	.819	Valid
X2.16	.725	Valid
X2.17	.720	Valid
X2.18	.732	Valid
X2.19	.855	Valid
X2.2	.883	Valid
X2.20	.879	Valid
X2.21	.856	Valid
X2.22	.836	Valid
X2.23	.741	Valid
X2.24	.781	Valid
X2.3	.855	Valid
X2.4	.866	Valid
X2.5	.762	Valid
X2.6	.793	Valid
X2.7	.825	Valid
X2.8	.712	Valid
X2.9	.742	Valid

Table 4
Average Variance Extracted

	Average Variance Extracted (AVE)
AG	.675
ASE	.926
GM	.643

Table 5
Composite Reliability Value

Latent Variable	Cronbach's alpha	Composite reliability (rho_a)
AG	.972	.974
ASE	.997	.998
GM	.976	.979

Table 6
Path coefficient and T-statistic

	T Statistic	Path coefficient
ASE -> AG	2.386	.018
GM -> AG	5.177	.000

Table 6 shows the results of hypothesis tests sourced from bootstrapping output with t-statistical values. The t-test value for the path coefficient of the influence of ASE on AG is 2.386 (> 1.96). From these results, academic self-efficacy has a positive and significant influence on grit. Additionally, the t-test value for the path coefficient of the influence of GM on AG is 5.177 (> 1.96). The mindset variable has a positive and significant influence on academic grit. In

this context, grit of civil engineering students is influenced by a mindset rather than academic self-efficacy.

Discussion

Individuals motivated to achieve long-term goals can enter a dreaming state and become resilient in pursuing long-term goals (Setyowati & Situmorang, 2022). Perseverance does not appear in the initial plan for long-term goals but can be subjected to challenging processes (Muhibbin & Wulandari, 2021; Ramdhani et al., 2018). Challenged individuals are capable of dedicating time and energy to face difficulties (Yokoyama, 2019). Therefore, grit as a positive trait has a significant impact on negative academic behaviors in students (Neroni et al., 2022; Septiania et al., 2018).

Academic self-efficacy and mindset play a significant role in shaping *grit*. These results confirm that perseverance in completing the final project is determined by intellectual ability, internal psychological factors (academic self-efficacy), and belief in the development of abilities. Students with a high level of self-efficacy are more confident in facing academic challenges and have a strong commitment to completing college assignments. According to Bandura (1977), self-efficacy plays a role in shaping motivation, perseverance, and response to failure. In this context, self-efficacy affects learning behavior, initiative, and mental resilience in completing heavy academic responsibilities.

The results reinforce the idea that the evolving mindset has a positive correlation with grit. Students who believe that abilities can be improved through effort tend to be more resistant to obstacles and failures. Dweck (2006) stated that a growth mindset encouraged individuals to continue learning and developing. In this context, mindset functions as a frame of mind that provides meaning to challenges and failures. In combination with self-efficacy, a growth mindset can strengthen commitment to a long and challenging academic process.

The contribution of academic self-efficacy and mindset in forming grit of 26.2% shows that there are more than 70% other factors affecting the variable. Several previous research identified other factors affecting grit, such as self-regulation (Tang et al., 2019), intrinsic motivation (Ghaybiyyah, 2021), independent learning strategies, social support, and the influence of the learning environment. High academic pressure, complex technical projects, and the demands of on-time graduation become a significant psychological burden. Therefore, adaptability, social support from family and friends, and the availability of academic guidance play a role in shaping student perseverance.

The practical implications are important for the managers of research programs and higher education institutions. Educational psychology-based interventions need to be designed to develop self-efficacy and a growth mindset. For example, soft skills training programs that include strengthening self-perception, reflection on the learning process, and simulations of academic decision-making are applied from the lecture period. A coaching-based method is applied to build long-term academic goals and increase confidence in the process. In addition, final project supervisors need to understand the importance of the psychological aspect in supporting students.

Based on the description, this research enriches academic literature in Indonesia, specifically in the field of psychology of engineering education. Grit has been analyzed in the context of general education while engineering students with complex cognitive and technical challenges have not received attention. Therefore, this research makes an important contribution to filling the gap, as well as encouraging further research to explore the interaction between other psychological variables such as academic anxiety, sense of belonging, and learning style on the formation of student grit in various disciplines.

Generalization of results should be conducted with caution even though this research found a significant relationship between mindset, self-efficacy, and grit. The limitations in the sample of civil engineering students from some universities may not reflect the overall population with diverse educational contexts. In this context, follow-up research with longitudinal design or mixed methods is highly recommended to better understand the process of grit formation over time, as well as identify effective interventions to develop persistent and resilient character in the context of Indonesian higher education.

Conclusion

In conclusion, academic self-efficacy and mindset played an important role in shaping grit, specifically in facing the challenges of preparing final projects. Grit as perseverance and resilience in achieving long-term goals was influenced by academic confidence. Learning motivation and other psychological factors also affected the development of grit. Different implications were provided for educational institutions to develop programs aimed at strengthening self-efficacy and student mindsets. The results were interpreted carefully due to the limitations of the context and sample. Follow-up research with a wider scope was recommended to reinforce the results and explore other variables contributing to grit.

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Appendix

