JPPIPA 10(12) (2024)

Jurnal Penelitian Pendidikan IPA

*Journal of Research in Science Education*

http://jppipa.unram.ac.id/index.php/jppipa/index

# Creativity and Self-Discipline as Predictors of Academic Success in Geospatial Engineering Education

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Received: August 30, 2024
Revised: November 06, 2024
Accepted: December 25, 2024
Published: December 31, 2024

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DOI: 10.29303/jppipa.v10i12.9646



**Abstract**: The Rapid development of geospatial technology and increasing industry demands for competent workforce necessitate a deeper understanding of factors influencing student academic success in geospatial engineering education. This research aims to examine the contribution of creativity and self-discipline to student learning outcomes in the Fundamentals of Geospatial Engineering course. Specifically, it analyzes: (1) the contribution of creativity to learning outcomes, (2) the contribution of self-discipline to learning outcomes, and (3) the simultaneous contribution of both factors to the learning outcomes of tenth-grade students in the Geomatics Engineering Program at SMK Negeri 1 Sarolangun. The results show that learning creativity and self-discipline have a significant joint influence on student learning outcomes. Specifically, learning creativity has a positive and significant effect, where every one-unit increase in creativity will increase learning outcomes by 0.311 units. Likewise, self-discipline also has a positive and significant effect, where every one-unit increase in discipline will increase learning outcomes by 0.184 units. Simultaneously, learning creativity and self-discipline contribute 73.5% to student learning outcomes. These findings emphasize the importance of considering psychological and socio-emotional aspects, such as creativity and self-discipline, in an effort to improve the quality of learning and academic success of students in geospatial engineering education. The results of this research can be utilized to develop more effective and comprehensive learning strategies in the context of vocational education, particularly in the field of geospatial engineering.

**Keywords**: Creativity; Geospatial Engineering Education; Learning Outcomes; Self-discipline

## Introduction

Vocational education has undergone significant transformation in recent decades, shifting from traditional learning models toward a more comprehensive approach oriented toward capability development (Khairiah et al., 2024; McGrath et al., 2022; Syaifullah et al., 2024). As part of the post-school education system, vocational education plays a crucial role in preparing students to meet the ever-changing demands of the workforce (Hyland, 2000; Lestari & Sunarso, 2024). In its development, vocational education theory has evolved to accommodate lifelong learning needs and more complex skill development (Mukhlis et al., 2024; Psacharopoulos, 1991; Spohrer, 2024; Sumitro & Rohman, 2024). Enhanced self-discipline and independent learning capacity have become key components in this transformation (Pokrovskaya et al., 2020; Trad et al., 2021), aligned with the demands of

**How to Cite:**
Ramadona, W., Heriyadi, B., & Syaifullah, L. (2024). Creativity and Self-Discipline as Predictors of Academic Success in Geospatial Engineering Education. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10851–10858. https://doi.org/10.29303/jppipa.v10i12.9646

adaptation to various emerging learning models (Claver et al., 2020).

Geospatial education, as a rapidly developing branch of vocational education, emphasizes the integration of technology and analytical skills in learning. The implementation of online learning resources such as Geobrain has enabled students to engage in more intensive data-based learning (Deng & Di, 2008). The use of mobile geospatial wikis and geo-tagging technology in civil engineering education has also shown promising potential in enhancing learning experiences (Safran et al., 2010).

Previous research has examined the relationship between creativity, self-discipline, and academic achievement in various educational contexts. (Barbachán Ruales et al., 2020) found a positive correlation between creativity levels and academic performance among mechanical engineering students, while (Swanzy-Impraim et al., 2023) revealed the importance of creativity development in visual arts teacher education. (García-Aranda et al., 2020) demonstrated how the integration of creativity and innovation in STEM education can improve learning outcomes. Regarding self-discipline, (Claver et al., 2020) identified relationships between motivation, discipline, and academic performance through a holistic approach. (Liu & Waugh, 2010) developed Rasch measurements to assess self-discipline in mathematics education, while (KE, 1951) emphasized the importance of balance between self-expression and self-discipline in education. (Hirsh & Peterson, 2008) successfully developed instruments to predict creativity and academic success using Big Five measurements.

However, geospatial education still faces various complex challenges. Despite efforts to develop effective evaluation methods (Ming-wei & Yan-ru, 2011) and implement blended learning (Chen & He, 2020), there remains a gap between theory and practice. These challenges are complicated by the need for creativity in geospatial problem-solving and the importance of self-discipline in managing intensive learning. (Cochrane et al., 2013) emphasizes the importance of effective virtual learning environment design, yet its implementation still faces various technical and pedagogical constraints.

Various efforts have been made to address these challenges, including the development of practice-based learning approaches and the utilization of open educational resources (Magetos et al., 2023). (Duan, 2021) proposed a blended learning approach in information environments to enhance the effectiveness of theoretical and practical learning. The integration of information technology in learning has also become a primary focus in efforts to improve vocational education quality (McGrath, 2012).

Although previous research provides valuable insights, no studies have specifically examined creativity and self-discipline as predictors of academic success in the context of geospatial engineering education. The novelty of this research lies in the integration of analysis of both factors within the specific context of geospatial engineering education, where both play important roles but have not been explored in depth. This research aligns with theoretical frameworks developed for education in developing countries (Buchmann & Hannum, 2001) and the importance of understanding factors influencing educational success in various contexts (Burde et al., 2017). The results of this research are expected to contribute to the development of more inclusive and transformative educational policies (Gillborn*, 2005) in the context of geospatial education, as well as enrich literature on factors influencing academic success in higher vocational education research

In line with the objectives and the growing development of geospatial technology and increasing industry demand for competent workforce, understanding the factors that influence students' academic success becomes crucial for developing effective educational programs (McGrath et al., 2022). Although creativity and self-discipline have been proven to influence academic achievement in various fields (Barbachán Ruales et al., 2020; Claver et al., 2020), there has been no comprehensive research examining the role of these two factors specifically in the context of geospatial engineering education. Thus, the results of this research are expected to provide an empirical basis for developing more directed learning strategies in building a balance between creativity and self-discipline (Hirsh & Peterson, 2008; KE, 1951), which is essential in geospatial engineering education to meet the demands of the digital era.

This research is important fo several reasons. First, the increasing industry demand for competent geospatial workforce requires a deep understanding of factors affecting students' academic success. Second, although creativity and self-discipline have been proven to influence academic achievement in various fields, there remains a research gap regarding the role of these two factors in the specific context of geospatial engineering education. Third, the results of this research can provide an empirical basis for developing more effective learning strategies in building a balance between creativity and self-discipline that is crucial in geospatial engineering education.

This research has three main objectives. First, to examine the contribution of creativity to learning outcomes in the Fundamentals of Geospatial Engineering course for tenth-grade students in the Geomatics Engineering Program. Second, to analyze the contribution of learning discipline to learning outcomes in the same subject. Third, to identify the simultaneous contribution of creativity and learning discipline to student learning outcomes in tenth-grade Geomatics Engineering Program at SMK Negeri 1 Sarolangun. The results of this study are expected to make a significant contribution to the development of more effective vocational education programs, particularly in the field of geospatial engineering.

## Method

This research employed a correlational quantitative approach to analyze the contribution of creativity and learning discipline to learning outcomes in the Fundamentals of Geospatial Technology subject. The research was conducted in three main stages: preparation, implementation, and data analysis, with the research flow as shown in Figure 1.

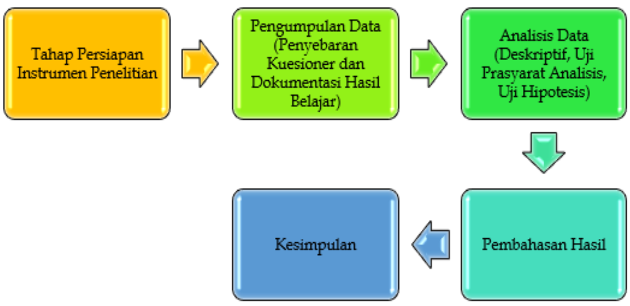


**Figure 1.** Research Flow

In the preparation stage, two main instruments were developed: a creativity questionnaire and a learning discipline questionnaire, both using a 5-point Likert scale. The creativity questionnaire measured four dimensions: fluency of thinking, flexibility of thinking, elaboration, and originality. The learning discipline questionnaire measured adherence to rules, participation in learning activities, completion of assignments, and home study habits. The population in this study consisted of 92 students, with a selected sample of 32 grade X students through purposive sampling based on three criteria: (1) actively enrolled in grade X, (2) taking the Fundamentals of Geospatial Technology subject, and (3) having completed the even semester evaluation of 2023/2024. The research was conducted at SMK Negeri 1 Sarolangun during the period of May-June 2024. Learning outcomes were measured using final semester grades in the Fundamentals of Geospatial Technology subject obtained through documentation.

Data analysis was conducted in three stages. First, descriptive analysis to examine data characteristics including mean, median, mode, and standard deviation. Second, prerequisite analysis tests including: normality test using Kolmogorov-Smirnov (p-value criteria > 0.05), linearity test using Test for Linearity (Deviation from Linearity criteria > 0.05), and multicollinearity test using VIF (VIF criteria < 10). Finally, hypothesis testing using simple and multiple regression analysis. Simple regression tests the influence of individual creativity and learning discipline on learning outcomes (using t-test, $p < 0.05$), while multiple regression tests simultaneous influence (using F-test, $p < 0.05$). The coefficient of determination ($R^2$) was calculated to measure the contribution of the predictor variables, with interpretations ranging from very weak (0.00-0.19) to very strong (0.80-1.00).

## Result and Discussion

This research data consists of three variables: Learning Creativity (X1), Learning Discipline (X2), and Student Learning Outcomes (Y). This data description reveals information about the mean, median, mode, standard deviation, range, lowest value, highest value, and total value. The distribution of data for Creativity, Learning Discipline, and Student Learning Outcomes was obtained using SPSS version 29 computer program. The obtained data can be seen in Table 1.

**Table 1.** Research Data Description

| | | Creativity | Discipline | Learning Outcomes |
|---|---|---|---|---|
| N | Valid | 32 | 32 | 32 |
| | Missing | 0 | 0 | 0 |
| Mean | | 71.69 | 74.50 | 82.06 |
| Median | | 7.00 | 78.00 | 84.50 |
| Mode | | 77 | 78 | 85 |
| Std. Deviation | | 10.237 | 14.023 | 5.576 |
| Variance | | 104.802 | 196.645 | 31.093 |
| Range | | 44 | 46 | 15 |
| Minimum | | 50 | 50 | 75 |
| Maximum | | 94 | 96 | 90 |
| Sum | | 2294 | 2384 | 2626 |

This research data consists of three variables: creativity, discipline, and learning outcomes. The sample size used was 32, with no missing data. For the creativity variable, the mean value was 71.69 with a median of 71.00 and a mode of 77. The standard deviation for creativity was 10.237 with a variance of 104.802. The lowest creativity score was 50, and the highest score was 94, with a range of 44. For the discipline variable, the mean value was 74.50 with a median of 78.00 and a mode of 78. The standard deviation for discipline was 14.023 with a variance of 196.645. The lowest discipline score was 50, and the highest score was 96, with a range of 46.

For the learning outcomes variable, the mean value was 82.06 with a median of 84.50 and a mode of 85. The standard deviation for learning outcomes was 5.576 with a variance of 31.093. The lowest learning outcome score was 75, and the highest score was 90, with a range of 15. Following the collection of research data, a normality test was conducted, the results of which can be seen in Table 2.

**Table 2.** Normality Test Results

| | | | Unstandardized Residual |
|---|---|---|---|
| N | | | 32 |
| Normal Parameters[a,b] | Mean | | 0.0000000 |
| | Std. Deviation | | 2.87798157 |
| Most Extreme Differences | Absolute | | 0.113 |
| | Positive | | 0.068 |
| | Negative | | -0.113 |
| Test Statistic | | | 0.113 |
| Asymp. Sig. (2-tailed)[c] | | | 0.200 |
| Monte Carlo Sig. (2-tailed) | Sig. | | 0.370 |
| | 99% Confidence Interval | Lower Bound | 0.357 |
| | | Upper Bound | 0.382 |

a. Test distribution is Normal.
b. Calculated from data.
Lilliefors Significance Correction.

The data presented in Table 2 was tested using the One-Sample Kolmogorov-Smirnov Test on unstandardized residual values. The sample size (N) used in the normality test was 32. Based on the test results, the residual mean value obtained was 0.0000000 with a standard deviation of 2.87798157. The largest Absolute value of Most Extreme Differences was 0.113. The test statistic value obtained was 0.113 with an Asymptotic significance value (Asymp. Sig. (2-tailed)) of 0.200. The Monte Carlo significance value (Monte Carlo Sig. (2-tailed)) was 0.370 with a 99% confidence interval ranging from 0.357 to 0.382. The normality test results indicated that the data was normally distributed, marked by significance values greater than 0.05, both asymptotically and using the Monte Carlo approach. After obtaining the normality test results, linearity tests were conducted, which can be seen in Table 3 for X1 against Y linearity test data and Table 4 for X2 against Y linearity test data.

**Table 3.** Linearity Test of X1 against Y

| Learning Outcomes * Learning Creativity | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Between Groups | (Combined) | 752.625 | 20 | 37.631 | 1.959 | 0.126 |
| | Linearity | 527.105 | 1 | 527.105 | 27.447 | 0.000 |
| | Deviation from Linearity | 225.520 | 19 | 11.869 | 0.618 | 0.828 |
| Within Groups | | 211.250 | 11 | 19.205 | | |
| Total | | 963.875 | 31 | | | |

Based on the linearity test shown in Table 3, results indicated a significant linear relationship between learning creativity (X1) and learning outcomes (Y). The F-value for linearity was 27.447 with a significance of 0.000, indicating a significant linear relationship between these two variables. Furthermore, the F-value for deviation from linearity was 0.618 with a significance of 0.828. The significance value greater than 0.05 indicated no significant deviation from the linearity assumption. In other words, the relationship between learning creativity (X1) and learning outcomes (Y) can be considered linear.

Regarding data variation, the Sum of Squares between groups was 752.625, while the Sum of Squares within groups was 211.250. This indicates that the data variation can be well explained by the linear regression model. Overall, the linearity test results showed a significant linear relationship between learning creativity (X1) and learning outcomes (Y), thus satisfying the linearity assumption.

**Table 4.** Linearity Test of X2 against Y

| Learning Outcomes * Learning Creativity | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| Between Groups | (Combined) | 845.375 | 21 | 40.256 | 3.397 | 0.025 |
| | Linearity | 433.707 | 1 | 433.707 | 36.600 | 0.000 |
| | Deviation from Linearity | 411.668 | 20 | 20.583 | 1.737 | 0.185 |
| Within Groups | | 118.500 | 10 | 11.850 | | |
| Total | | 963.875 | 31 | | | |

Based on the linearity test results shown in Table 4, there was a significant linear relationship between learning discipline (X2) and learning outcomes (Y). This was indicated by an F-value for linearity of 36.600 with a significance of 0.000. The significance value less than 0.05 indicated a significant linear relationship between these two variables.

Furthermore, the F-value for deviation from linearity was 1.737 with a significance of 0.185. The significance value greater than 0.05 indicated no significant deviation from the linearity assumption. This means the relationship between learning discipline (X2) and learning outcomes (Y) can be considered linear. Regarding data variation, the Sum of Squares between groups was 845.375, while the Sum of Squares within groups was 118.500.

This indicates that the data variation can be well explained by the linear regression model. Overall, the linearity test results showed a significant linear relationship between learning discipline (X2) and learning outcomes (Y), thus satisfying the linearity assumption. After obtaining the linearity data, multiple regression analysis was conducted to test the combined effect of creativity (X1) and discipline (X2) variables on learning outcomes (Y). The multiple regression analysis results can be seen in Table 5 for multiple regression results and Table 6 for coefficient values.

**Table 5.** Multiple Regression Results

| Model | | Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 707.109 | 2 | 353.554 | 39.932 | <.001b |
| | Residual | 256.766 | 29 | 8.854 | | |
| | Total | 963.875 | 31 | | | |

a. Dependent Variable: Hasil_Belajar
b. Predictors: (Constant), Discipline, Creativity

**Table 6.** Coefficient Values

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 46.014 | 4.100 | | 11.222 | 0.000 |
| | Kreativitas | 0.311 | 0.056 | 0.571 | 5.557 | 0.000 |
| | Disiplin | 0.184 | 0.041 | 0.464 | 4.509 | 0.000 |

a. Dependent Variable: Learning_Outcomes

The regression model testing results showed that this model was statistically significant. This was evidenced by the calculated F-value of 39.932 and significance $p < 0.001$, which is less than the significance level of 0.05. These results indicate that the creativity (X1) and discipline (X2) variables jointly have a significant effect on learning outcomes (Y). The Sum of Squares Regression value of 707.109 from the Total Sum of Squares of 963.875 shows that these two independent variables can explain 73.5% of the variation in the learning outcome variable.

Therefore, it can be concluded that the multiple regression model consisting of creativity (X1) and discipline (X2) variables as predictors is significant in predicting learning outcomes (Y). Both independent variables together make a substantial contribution of 73.5% in explaining the variance that occurs in the learning outcome variable.

Based on the multiple regression analysis results, the regression equation to predict learning outcomes (Y) is as follows: Learning Outcomes = 46.014 + 0.311 Creativity + 0.184 Discipline. This equation explains that both creativity (X1) and discipline (X2) variables have a positive influence on learning outcomes. The regression coefficient for the creativity variable is 0.311, meaning that each one-unit increase in creativity will increase learning outcomes by 0.311 units, assuming the discipline variable remains constant. Meanwhile, the regression coefficient for the discipline variable is 0.184, indicating that each one-unit increase in discipline will increase learning outcomes by 0.184 units, assuming the creativity variable remains constant.

Significance testing of the effects showed that both creativity and discipline variables have a significant influence on learning outcomes. This is indicated by the t-value being significant at the 0.05 level for each independent variable. Overall, it can be concluded that creativity and learning discipline together have a positive and significant effect on student learning outcomes. The higher the level of student creativity and learning discipline, the better the learning outcomes obtained.

This research demonstrates that learning creativity (X1) and learning discipline (X2) jointly have a significant influence on student learning outcomes (Y) in the Fundamentals of Geospatial Technology course. This is evidenced by the multiple regression model's significance value being less than 0.05, specifically $p < 0.001$. In detail, the analysis results show that learning creativity (X1) has a positive and significant effect on learning outcomes (Y). Each one-unit increase in learning creativity will improve learning outcomes by 0.311 units, assuming the learning discipline variable remains constant. These findings align with previous research that revealed a positive correlation between creativity levels and academic performance among engineering students (Barbachán Ruales et al., 2020) and the importance of creativity development in STEM education (García-Aranda et al., 2020).

Additionally, learning discipline (X2) also has a positive and significant effect on learning outcomes (Y). Each one-unit increase in learning discipline will improve learning outcomes by 0.184 units, assuming the creativity variable remains constant. These findings are consistent with previous research that identified relationships between motivation, discipline, and academic performance (Claver et al., 2020) and the importance of balance between self-expression and self-discipline in education (KE, 1951). Overall, this research shows that learning creativity and learning discipline together contribute 73.5% to student learning outcomes in the Fundamentals of Geospatial Technology course. These findings emphasize the importance of attending to psychological and socio-emotional factors, such as creativity and learning discipline, in order to enhance student academic success, particularly in the context of increasingly complex geospatial technology education that requires strong integration of technology and analytical skills.

This research makes important contributions to the development of vocational education policies and practices, particularly in the field of geospatial technology. These research findings can be utilized to design more effective learning strategies, emphasizing balanced development of student creativity and learning discipline. This aligns with theoretical frameworks that emphasize the importance of understanding factors affecting educational success in various contexts (Buchmann & Hannum, 2001; Burde et al., 2017). Furthermore, this research also provides new insights regarding factors influencing academic success in vocational education, particularly in geospatial technology. These findings can enrich existing literature and encourage further research to explore more deeply the dynamics between creativity, learning discipline, and academic success in the increasingly complex context of vocational education.

## Conclusion

This research aimed to analyze the contribution of creativity and learning discipline to student learning outcomes in the Fundamentals of Geospatial Technology course. The results show that learning creativity and learning discipline together have a significant influence on student learning outcomes. Specifically, learning creativity has a positive and significant effect, where each one-unit increase in creativity will improve learning outcomes by 0.311 units. Similarly, learning discipline also has a positive and significant effect, where each one-unit increase in discipline will improve learning outcomes by 0.184 units. Simultaneously, learning creativity and learning discipline contribute 73.5% to student learning outcomes. These research findings emphasize the importance of attending to psychological and socio-emotional aspects, such as creativity and learning discipline, in efforts to improve learning quality and student academic success in geospatial technology education. These research findings can be utilized to develop more effective and comprehensive learning strategies in the context of vocational education, particularly in the field of geospatial technology.

**Acknowledgments**

The authors would like to express their gratitude to the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia for providing the research grant that made this research possible. We also extend our sincere appreciation to the faculty and staff of the Department of Geospatial Engineering at SMK Negeri 1 Sarolangun for their invaluable support and cooperation during the data collection process.

**Author Contributions**

For this research article, the authors had distinct roles in its preparation and execution. Widia Ramadona (W.R.) and Bambang Heriyadi (B.H.) were responsible for the conceptualization of the research. W.R. developed the methodology and conducted the investigation, while B.H. provided supervision throughout the research process. L.S. handled the software implementation and formal analysis of the data. The validation process was conducted jointly by W.R., B.H., and L.S. W.R. was responsible for resource management, data curation, and original draft preparation. B.H. oversaw the review and editing process and secured funding for the research. L.S. contributed to the visualization of the research data and assisted with translation. W.R. managed the project administration. All authors have read and agreed to the published version of the manuscript.

**Funding**

This research received no external funding.

**Conflicts of Interest**

The authors declare no conflict of interest. The funders had no role in the design of the research; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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