International Journal of Global Accounting, Management, Education, and Entrepreneurship (IJGAME2)
URL : https://jurnal.stiepemuda.ac.id/index.php/ijgame2

P- ISSN : 2723-2948
E- ISSN : 2723-2204

ANALYSIS OF THE CORRELATION BETWEEN BASIC MATHEMATICAL SKILLS AND SUCCESS IN LEARNING INTRODUCTORY PROGRAMMING AMONG FIRST-SEMESTER INDUSTRIAL ENGINEERING STUDENTS

Angga Gama Kurnia Dewa[1], Chandra Kirana[2], Dessy Srikandi[3]
gama@upms.ac.id[1] ,chandrakirana@upms.ac.id[2], dessy@upms.ac.id

Universitas PGRI Mpu Sindok (Indonesia) [1,2,3]

ABSTRACT

Introductory programming is a vital course for Industrial Engineering students, as it supports data analysis, simulation, and systems modeling. However, students' understanding of programming is significantly influenced by basic mathematical skills, particularly logic, algebra, and arithmetic. This study aims to analyze the relationship between basic mathematical skills and success in learning introductory programming among first-semester Industrial Engineering students. The research employs a quantitative approach, using basic mathematics tests and programming learning evaluations as instruments. Data analysis was conducted using Pearson's correlation to determine the degree of relationship between the two variables. The results indicate a significant positive correlation between basic mathematical skills and programming success. Students with better mathematical skills tend to grasp algorithms, control structures, and debugging more quickly. These findings underscore the importance of strengthening basic mathematics as a foundation for programming and provide recommendations for educational institutions to offer math reinforcement modules for freshmen.

Keywords: *Basic mathematics; computer programming; introductory programming; industrial engineering; first-semester students; correlation; Pearson*

A. INTRODUCTION

The Industrial Revolution 4.0 requires students across various disciplines to possess skills in information and communication technology, especially in basic programming. Programming is viewed not merely as a technical skill but as a means for logical, systematic, and analytical thinking to solve modern industrial problems. Consequently, introductory programming has become a mandatory course in the Industrial Engineering curriculum. However, success in this subject is often influenced by prior knowledge, such as basic mathematics encompassing algebra, arithmetic, and logic—which serves as the universal language underlying algorithms and programming structures. Concepts such as variables, functions, loops, and decision-making are closely linked to mathematical skills. While non-cognitive factors like motivation and study strategies also play a role, basic mathematical skills remains a critical measurable variable in determining academic achievement in programming. This study examined the relationship between basic mathematical skills and success in learning introductory programming among first-semester Industrial Engineering students. By employing a quantitative correlational approach, this research aims to provide concrete evidence regarding the importance of basic mathematics mastery as a prerequisite for learning.

Furthermore, the findings are expected to provide valuable input for department heads in designing curricula, instructional strategies, and support programs to enhance students' readiness for logic-based and analytical courses.(Arifin et al., 2025). Several previous studies have emphasized the important role of mathematical skills in supporting programming learning. Mathematics is widely recognized as a foundational discipline that contributes to the development of algorithmic thinking, logical reasoning, and problem-solving skills, all of which are essential in programming (Sofowora et al., 2022). Core mathematical competencies such as algebra, arithmetic, and logic are closely related to programming constructs, including variables, control structures, and functions.

Research by Cornillez et al. (2020) demonstrated that mathematical competence is a significant predictor of students' programming performance. Their findings indicate that students with higher levels of mathematical reasoning tend to design more efficient algorithms and exhibit better debugging skills. Similarly, Firdaus et al. (2020) found a positive relationship between mathematics achievement and object-oriented programming performance among vocational high school students, suggesting that mathematical ability plays a critical role across different educational levels.

In addition, Saeed et al. (2021) reported that students with strong mathematical backgrounds show greater confidence and adaptability in learning programming languages. This is because mathematical training enhances abstract thinking and the ability to break down complex problems into structured steps (Anggraini & Arifin, 2023). Furthermore, Ala-Mutka (2004) highlighted that difficulties in programming are often linked to weak problem-solving and logical thinking skills, which are fundamentally rooted in mathematical understanding. Other studies also support the relationship between mathematical ability and programming success. Gomes and Mendes (2007) identified that students with insufficient mathematical foundations often struggle with introductory programming courses, particularly in understanding algorithmic logic. Meanwhile, Bergin and Reilly (2005) emphasized that cognitive abilities, including mathematical reasoning, significantly influence students' performance in programming modules. Moreover, Wilson and Shrock (2001) found that prior academic skills, including mathematics, are among the strongest predictors of success in introductory programming courses. Their study suggests that students who lack basic mathematical skills are more likely to experience difficulties in learning programming concepts. Despite the growing body of literature highlighting the importance of mathematics in programming education, most existing studies have focused on general student populations or computer science majors (Arifin, 2020). There is still limited research specifically examining first-semester Industrial Engineering students, who may have diverse academic backgrounds and varying levels of mathematical preparedness. Therefore, this study aims to fill this gap by providing empirical evidence on the relationship between basic mathematical skills and success in learning introductory programming within this specific context.

B. RESEARCH METHOD

This study employs a quantitative, correlational approach. The quantitative approach was selected because the study focuses on numerical measurement of basic mathematical skills and success in learning introductory programming, along with the analysis of linear relationships between variables using inferential statistics. Pearson's correlation was specifically chosen to determine the strength and direction of the relationship between these two variables. The primary objective is to identify the correlation between basic mathematical skills and success in introductory programming. The research was conducted within the Industrial Engineering Study Program with a sample of 15 students. Data collection took place during regular lecture hours. The sampling process utilized a purposive sampling method, targeting Industrial Engineering students who had already completed the introductory programming course. In this study, the independent variable is the students' basic

mathematical skills, covering algebra, logic, and basic arithmetic. Meanwhile, the dependent variable is success in learning introductory programming, measured by scores from practical assessments covering algorithmic logic, Python usage, and simple code logic.

The data collection techniques involved written tests to assess basic mathematical skills, as well as both practical and written tests for the introductory programming course. The research procedure commenced with instrument design, followed by validity and reliability testing. A basic mathematics test was administered prior to the start of the semester, while the programming test was conducted during the Midterm Examination (UTS). Subsequently, the scores and their squares for both variables were calculated to perform Pearson's correlation analysis, which determines the strength and direction of the relationship between the two variables.

In addition, instrument validity was assessed using content validity by consulting subject matter experts in mathematics and programming education. Reliability testing was conducted using Cronbach's Alpha to ensure the consistency of the instruments. The results indicated that all instruments met the acceptable reliability threshold.It should be noted that the sample size in this study is relatively small (n = 15), which may limit the generalizability of the findings. However, this study is intended as a preliminary investigation to identify initial empirical evidence regarding the relationship between basic mathematical skills and programming learning outcomes

C. RESEARCH & DISCUSSION RESULTS

1. Results of Basic Ability and Introductory Programming Tests.
   To facilitate the data analysis, variables were defined as follows.
   X = Basic Mathematical Skills
   Y = Success in Learning Introductory Programming
   The scores obtained for both variables are presented in Table 1 below.

Tabel 1. Results of Both Variables

No	Respondents	X	Y
1	Harist Arya	70	72
2	Johan Sendy	65	68
3	Moch. Fandy	80	85
4	Pralita Geofani	60	62
5	Ahmad Heru	75	78
6	Abel Najwa	68	70
7	Anisa Ul Kholifah	82	88
8	Desi Rufiana	77	80
9	Erica Dewi	72	74
10	Elsa Festira	85	90
11	Gushtyna	66	69
12	Hanna Fitria	78	82
13	Irwan Yudha	74	76
14	Kholisotul Ro'ifah	69	71
15	Laila Fitriana	81	86
	Sum	**1102**	**1151**

Based on the data in Table 1, the squares of each value for both variables were calculated. The resulting data is presented in Table 2 as follows.

Tabel 2. The results of the calculation of the square of each variable

No	Respondents	X	Y	X^2	Y^2	X.Y
1	Harist Arya	70	72	4900	5184	5040
2	Johan Sendy	65	68	4225	4624	4420
3	Moch. Fandy	80	85	6400	7225	6800
4	Pralita Geofani	60	62	3600	3844	3720
5	Ahmad Heru	75	78	5625	6084	5850
6	Abel Najwa	68	70	4624	4900	4760
7	Anisa Ul Kholifah	82	88	6724	7744	7216
8	Desi Rufiana	77	80	5929	6400	6160
9	Erica Dewi	72	74	5184	5476	5328
10	Elsa Festira	85	90	7225	8100	7650
11	Gushtyna	66	69	4356	4761	4554
12	Hanna Fitria	78	82	6084	6724	6396
13	Irwan Yudha	74	76	5476	5776	5624
14	Kholisotul Ro'ifah	69	71	4761	5041	4899
15	Laila Fitriana	81	86	6561	7396	6966
Sum		**1102**	**1151**	**85385**	**81674**	**89279**

$(\sum X)$ = 1102
$(\sum X)^2$ = 1214404
$(\sum X^2)$ = 81674
$(\sum Y)$ = 1151
$(\sum Y)^2$ = 1324801
$(\sum Y^2)$ = 89279
$(\sum X.Y)$ = 85383
n = 15 (Number of Respondents)

Substitute the values into the Pearson Correlation formula:

$$r = \frac{n\sum XY - \sum X.\sum Y}{\sqrt{(n\sum X^2 - (\sum X)^2) \cdot (n\sum Y^2 - (\sum Y)^2)}}$$

$$r = \frac{15\,.\,85383 - 1102\,.\,1151}{\sqrt{(15\,.\,81674 - 1214404) \cdot (15\,.\,89279 - 1324801)}}$$

$$r = \frac{1280745 - 1268402}{\sqrt{(1225110 - 1214404) \cdot (1339185 - 1324801)}}$$

$$r = \frac{12343}{\sqrt{10706\,.\,14384}}$$

$$r = \frac{12343}{12409{,}47}$$

$$r = 0{,}9946$$

Based on the Pearson correlation, a value of 0.99 was obtained. According to the Pearson correlation criteria, a value of 0.99 indicates an extremely strong relationship between basic mathematical skills and success in learning introductory programming. These

results demonstrate that students with high or proficient basic mathematical skills tend to possess superior learning capabilities in introductory programming.

The finding of a very strong correlation ($r \approx 0.99$) indicates a close relationship between mathematical skills and programming ability. This result is consistent with previous studies, such as Cornillez et al. (2020) and Sofowora et al. (2022), which highlight that mathematical competence significantly influences students' programming performance. However, the extremely high correlation value should be interpreted with caution. This may be influenced by the relatively small sample size or the homogeneity of respondents. Therefore, further studies with larger and more diverse samples are necessary to validate these findings. In addition, this study only focuses on one independent variable, namely basic mathematical skills. Other factors such as learning motivation, prior programming experience, and learning strategies were not included in this model. These variables may also contribute to students' success in learning programming and should be considered in future research. The finding of a very strong positive correlation ($r \approx 0.99$) indicates that basic mathematical skills play a crucial role in determining students' success in learning introductory programming. This result is in line with previous studies that highlight the importance of mathematical competence in programming education. For instance, Cornillez et al. (2020) found that students with strong mathematical reasoning skills tend to achieve better performance in programming courses, particularly in designing algorithms and solving computational problems. Similarly, Sofowora et al. (2022) emphasized that mathematical ability significantly influences students' understanding of programming logic and structure.

Furthermore, the results of this study are also supported by Wilson and Shrock (2001), who identified that prior academic skills, including mathematics, are strong predictors of success in introductory programming courses. Students with better mathematical backgrounds are more capable of understanding abstract concepts and applying logical structures in coding tasks.(Widawati & Arifin, 2021)

In addition, Bergin and Reilly (2005) stated that cognitive abilities, especially those related to mathematical reasoning, have a significant impact on programming performance. This suggests that students' ability to think analytically and systematically, which is developed through mathematics, contributes directly to their success in programming learning.

Moreover, Gomes and Mendes (2007) highlighted that one of the main difficulties faced by students in learning programming is the lack of logical and problem-solving skills, which are closely related to mathematical understanding. This supports the argument that strengthening mathematical foundations can improve students' ability to grasp programming concepts more effectively.

However, the extremely high correlation value observed in this study should be interpreted with caution. Similar studies generally report moderate to strong correlations, rather than near-perfect relationships. This discrepancy may be influenced by the relatively small sample size or the homogeneity of the respondents. Therefore, further research with larger and more diverse samples is necessary to validate these findings and ensure their generalizability.

D. CONCLUSION

Based on the analysis of basic mathematical skills and introductory programming test results conducted within the first-semester Industrial Engineering program, the following conclusions can be drawn: 1) The results of the basic mathematics ability test show a strong correlation with learning outcomes in the introductory programming course. This implies that students with proficient basic mathematical skills tend to achieve superior results in introductory programming. This relationship is empirically supported

by a Pearson correlation coefficient of 0.9946, indicating that basic mathematical proficiency significantly influences and is a vital prerequisite for success in introductory programming.

Despite these findings, this study has several limitations, particularly in terms of sample size and the limited number of variables analyzed. Therefore, future research is recommended to include additional variables and a larger sample size to obtain more comprehensive results.

E. REFERENCES

Anggraini, D. S., & Arifin, S. (2023). Analisis Du Pont System dengan Time Series Analysis untuk Mengukur Kinerja Keuangan PT Widmarine Jaya Lines Tahun 2019-2022. *Mufakat: Jurnal Ekonomi, Manajemen Dan Akuntansi*, *2*(5), 455–463.

Ala-Mutka, K. (2004). Problems in learning and teaching programming. Codewitz Needs Analysis.

Arifin, S. (2020). Analysis of Education Level and Income Effect to the Number of Poor Inhabitant in Indonesia. *International Journal of Global Accounting, Management, Education, and Entrepreneurship*, *1*(1), 45–55.

Arifin, S., Murwani, F. D., Mukhlis, I., & Winarno, A. (2025). Exploring Cultural Education and Economic Influences on People's Well-Being: Voices from Indonesia. *Educational Process: International Journal*, *18*, e2025503 .

Bergin, S., & Reilly, R. (2005). Programming: Factors that influence success. ACM SIGCSE Bulletin, 37(1), 411–415. https://doi.org/10.1145/1047124.1047480

Cornillez Jr., E. E. C., Treceñe, J. K. D., & de los Santos, J. R. N. (2020). Mining educational data in predicting the influence of mathematics on the programming performance of university students. Indian Journal of Science and Technology, 13(26), 2668–2677. https://doi.org/10.17485/IJST/v13i26.719

Firdaus, A. A., Nashiroh, P. K., & Djuniadi. (2020). Hubungan nilai matematika dengan prestasi belajar pemrograman berorientasi objek pada siswa kelas XII jurusan RPL SMK Ibu Kartini Semarang. Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI), 9(1). https://doi.org/10.23887/janapati.v9i1.22680

Gomes, A., & Mendes, A. J. (2007). Learning to program—difficulties and solutions. Proceedings of the International Conference on Engineering Education.

Kadir, A. (2024). Logika pemrograman Python.

Saelan, M. A. (2020). Dasar-dasar algoritma, struktur data dan pemrograman.

Saeed, S., et al. (2021). The role of mathematical skills in programming education

Sofowora, M. A., Eyono Obono, S. D., & Abayomi, A. (2022). The influence of mathematics on students' performance in computer programming. In Innovations in Smart Cities Applications (Vol. 5). Springer. https://doi.org/10.1007/978-3-030-66840-2_32.

Widawati, E., & Arifin, S. (2021). Equity Crowdfunding As Msme Financing Alternative To Improve Business Competitiveness in the Time of Covid-19 (Case Study in Pak Min Chicken Sop). *International Journal of Global Accounting, Management, Education, and Entrepreneurship*, *1*(2), 155–162.

Wilson, B. C., & Shrock, S. (2001). Contributing to success in an introductory computer science course: A study of twelve factors. ACM SIGCSE Bulletin, 33(1), 184–188. https://doi.org/10.1145/364447.364581