



# Empowering High School Students with Software-Based Mathematical Skills for College and Career Readiness

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## Abstract

In the current data-driven era, data literacy is a critical competency. However, many high school students lack practical training in essential software like Microsoft Excel, creating a significant skills gap. To address this challenge, the Mathematics Study Program at Universitas Kebangsaan Republik Indonesia conducted a community service program designed to empower high school students with foundational data analysis and visualization skills through a structured, hands-on Excel workshop. The program employed a phased approach, beginning with an introductory session for 31 students, followed by an intensive training workshop for a final cohort of 12 students. The workshop was segmented into three progressive modules: Foundations of Data Management, Logical Analysis and Data Interpretation, and Data Visualization. The program's effectiveness was evaluated using qualitative performance-based assessments and a feedback survey to measure changes in skill and confidence. The results indicate that the training was highly successful, demonstrably improving participants' competence and confidence, as evidenced by overwhelmingly positive survey feedback. The foundational and data visualization modules were particularly effective, while the module on logical functions was identified as the most significant challenge for students. This initiative not only succeeded in delivering essential digital skills for college and career readiness but also offered valuable pedagogical insights, confirming the effectiveness of hands-on workshops and highlighting areas for refinement in technical education.

*Keywords:* Data Literacy, Microsoft Excel, Community Service, High School Education, Digital Skills

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## 1. Introduction

In today's data driven, data literacy has become a fundamental competency that the younger generation must possess to thrive in academic, professional, and social contexts. Data literacy encompasses the ability to acquire, analyze, represent, and communicate data effectively, which is crucial for making informed decisions in a data-centric world (Bhargava, 2019; Griffin & Holcomb, 2023). The integration of data literacy into education should begin early, with middle and high school students learning to distinguish between data and information, critically assess data sources, and understand the role of data in various disciplines (Ercegovic, 2015). Students need foundational knowledge to succeed in a society that is now driven by data. Therefore, it is essential to create a comprehensive data literacy learning system suitable for educational levels from elementary to high school (Jeong & Lee, 2024).

The ability to read and understand data (data literacy) is now not only important in school but also highly demanded in the workplace. In this digital age, data skills have become a primary competency. All employees, regardless of their position, are expected to be able to work with data. They must be able to experiment based on data and create innovative products or services from it (Miloradov et al., 2022). To this end, school curricula and job training programs must begin to incorporate data literacy materials. The goal is to prepare everyone to handle the vast and diverse amounts of data in modern industries (Leon-Urrutia et al., 2022). The tools and technology used in schools also play a major role in shaping how young people interact with data. Thus, it is crucial to teach students how to collect, analyze, and present data effectively (Miloradov et al., 2022). In essence, fostering data literacy in both educational and professional environments is vital for creating a "data-literate" generation capable of succeeding and contributing to a society that heavily relies on data.

Microsoft Excel is an essential tool in various sectors, including education, business, research, and government, due to its extensive capabilities in data processing, analysis, and visualization. In a business context, Excel is recognized as an industry-standard tool for analyzing and presenting results, making it indispensable for management and business applications (Liengme, 2000). The software's flexibility extends to educational settings, where it enhances students' understanding of statistical concepts and data analysis, as evidenced by its effectiveness in statistics courses (Simaremare & Siregar, 2024).

Excel is a crucial tool that transforms raw data into meaningful insights through formulas and data visualization tools, making it valuable in business analysis (Talib & Mohamad, 2020). Its role extends to teaching numerical methods, and its integration with VBA allows for advanced computational tasks for engineering and scientific applications (Kuka & Karamani, 2011). Its ability to handle complex datasets and perform mathematical operations such as regression modeling and financial data analysis underscores its importance in data-driven disciplines (Mustafy & Rahman, 2024). The demand for Excel skills in the job market is significant, with many middle-skilled jobs requiring at least a basic understanding of spreadsheets, highlighting the software's ubiquitous presence in business environments (Formby et al., 2017). Overall, Excel's comprehensive suite of tools for data manipulation, analysis, and visualization makes it an essential skill for students and professionals, facilitating the understanding and communication of complex data across various domains.

However, the reality on the ground shows that a majority of high school students, particularly outside of major cities, have not received access to or practical training in using Excel optimally. Information technology education in schools often covers only basic theory without delving into applied skills like data analysis and visualization. This situation has the potential to create a numeracy and digital literacy gap among students.

As a tangible contribution to addressing this challenge, the Mathematics Study Program at Universitas Kebangsaan Republik Indonesia, through its Community Service Program, has taken the initiative to organize structured training on data analysis and visualization using Microsoft Excel for partner high school students. This activity is designed as a full-day, interactive, and hands-on workshop to ensure that students not only understand the concepts but also become skilled in their application.

This training supports the achievement of the Sustainable Development Goals (SDGs), specifically SDG 4 concerning Quality Education, by promoting the enhancement of numeracy and digital literacy at the secondary school level. Additionally, this program aligns with the national development vision through the 6th Asta Cita, which is "to realize a productive, independent, and competitive society," achieved partly through improving the quality of education and technology mastery. By strengthening data processing and presentation skills from an early age, it is hoped that students can grow into data-literate individuals who are critical of information and ready to contribute to knowledge-based national development.

## **2. Materials and Methods**

### **2.1. Materials**

The training is segmented into three progressive modules, each designed to build upon the last, moving from fundamental operations to data visualization and communication. The curriculum concludes with a capstone evaluation to assess skill acquisition.

**Module 1: Foundations of Data Management in Excel.** The initial module establishes a strong foundation by introducing participants to the core Excel environment. The training covers navigation of the workspace, including the roles of cells, rows, columns, and worksheets. Participants engage in hands-on exercises to practice essential skills such as efficient data entry, table construction, and basic formatting. The module culminates in the application of fundamental functions (SUM, AVERAGE, MAX, MIN, COUNT) through a practical case study, such as calculating class-wide student averages or summarizing monthly expenditures. The primary objective is to build confidence and proficiency in basic data handling.

**Module 2: Logical Analysis and Data Interpretation.** The second module transitions from data management to data analysis. Participants learn to identify simple patterns and trends within datasets. The core of this section is mastering logical functions (IF, COUNTIF, AVERAGEIF) to perform conditional analysis and automate data segmentation. Through exercises like summarizing survey results on student engagement or attendance, participants learn to categorize data and extract more nuanced insights. The objective is to develop the critical thinking skills required to ask questions of the data and use logical tools to find the answers.

**Module 3: Data Visualization and Storytelling.** The final instructional module focuses on translating numerical data into compelling visual narratives. Participants are introduced to the principles of effective data visualization and learn to create standard chart types, including bar, pie, and line charts. A key component of this module is understanding how to select the most appropriate chart to convey a specific message or highlight a particular trend. Participants will apply these skills by transforming the analyses from Module 2 into a clear and professional visual report. The objective is to empower participants to communicate their findings effectively to a broader audience.

**Program Conclusion: Evaluation and Reflection.** The program concludes with a session dedicated to evaluation and reflection. Participant learning is assessed based on the quality of their completed projects, their active engagement

throughout the modules, and their ability to articulate their analytical process and results. This session also serves as a forum for participants to provide feedback and reflect on the practical benefits of their new skills.

## 2.2. Methods

This study employed a community service program methodology executed through a structured, hands-on workshop format. The primary objective of the design was to deliver a targeted educational intervention aimed at enhancing the data literacy and practical Microsoft Excel skills of the participants. The program was designed with a progressive learning curve, ensuring foundational concepts were mastered before advancing to more complex analytical and visualization techniques, as detailed in the Materials section.

The community service program was conducted in August 2025. The activity took place at SMAS Sebelas Maret, a senior high school located in Bandung, West Java. The participants were students of SMAS Sebelas Maret who voluntarily enrolled in the training program. The selection of participants was based on their interest in developing digital skills, without prerequisites for prior knowledge of Microsoft Excel.

The implementation of the workshop followed the sequential structure of the three modules outlined in the Materials section. The procedure was carried out as follows:

- a. **Introduction and Foundational Training:** The session began with an introduction to the program's objectives, followed by the delivery of Module 1: Foundations of Data Management in Excel. This phase involved live demonstrations by the facilitator, immediately followed by guided, hands-on exercises for the participants.
- b. **Analytical Skill Development:** After establishing a solid foundation, the program transitioned to Module 2: Logical Analysis and Data Interpretation. In this phase, participants worked with sample datasets to apply logical functions, with facilitators providing real-time support and guidance.
- c. **Data Communication and Visualization:** The instructional portion of the workshop concluded with Module 3: Data Visualization and Storytelling. Participants applied their analytical results from the previous module to create various charts, learning to select the most effective visual representation for their data.
- d. **Capstone Assessment and Reflection:** The program culminated in the Program Conclusion: Evaluation and Reflection session. Participants were given time to finalize their mini-projects, which were then reviewed. The session concluded with a guided discussion for reflection and feedback.

The effectiveness of the program was assessed using a qualitative, performance-based evaluation method. Data on skill acquisition and program impact were collected through three primary techniques:

- a. **Project-Based Assessment:** A direct evaluation of the final project outputs (completed Excel workbooks and data visualizations) submitted by each participant. This served as the primary measure of their ability to apply the learned concepts.
- b. **Observational Assessment:** Systematic observation of participant engagement and active participation during the hands-on exercises and Q&A sessions.
- c. **Verbal Articulation Assessment:** Evaluation of each participant's ability to explain their analytical process and the reasoning behind their data visualization choices during the final reflection session.

## 3. Results and Discussion

### 3.1. Training Program

This community service program was strategically executed in two distinct but interconnected phases: a broad socialization session and an intensive technical training workshop. The target participants for the program were students from SMAS Sebelas Maret in Bandung.

The initial engagement began with a program socialization session, which attracted a total of 31 students. This phase served as a general introduction to the field and its applications. Following this session, a more focused, hands-on workshop on Microsoft Excel was offered. From the initial group, 13 students registered to advance to this technical training. One participant had to withdraw shortly after the workshop began due to an urgent personal matter, resulting in a final cohort of 12 students who completed the entire training program.



**Figure 1:** Socialization of the Mathematics Study Program, FMIPA UKRI

The first phase of the initiative was a socialization session designed to introduce the academic programs offered by the Faculty of Mathematics and Natural Sciences (FMIPA) at Universitas Kebangsaan Republik Indonesia (UKRI). The primary objective extended beyond simple program promotion; the session aimed to build a strong conceptual foundation by illustrating the fundamental role of mathematics in analyzing and solving complex, real-world problems. The presentation focused on bridging the gap between theoretical mathematics and its practical, tangible applications in various industries. To foster genuine engagement, the session was conducted in an interactive format, encouraging an open dialogue where students could ask questions and provide feedback. This approach was intended to deepen their appreciation for the relevance of mathematical sciences and set the stage for the practical skills to be taught in the next phase.

Building upon the contextual understanding established in the socialization phase, the program transitioned into a hands-on technical training workshop structured into three progressive modules.

The workshop commenced with a foundational module focused on familiarizing participants with the Microsoft Excel environment. This included a comprehensive introduction to the user interface, covering the ribbon, formula bar, cells, rows, and columns. The pedagogical focus was on building confidence and competence in navigating the software. Subsequently, participants were trained to perform fundamental arithmetic operations (addition, subtraction, multiplication, and division) within Excel. This segment served as a crucial first step, providing the essential building blocks for all subsequent mathematical and data-driven computations.



**Figure 2:** Training on the Introduction to Microsoft Excel and Basic Arithmetic

In the second module, the curriculum advanced from basic computation to data analysis. The core of this section was dedicated to processing data using Excel's powerful logical functions. Participants received detailed instruction on the implementation and practical application of key functions, including IF, SUMIF, COUNTIF, and AVERAGEIF. The objective was to empower students to perform conditional analysis, allowing them to segment data, automate summaries based on specific criteria, and extract more nuanced insights. Learning was reinforced through mathematical case studies and other practical problem-solving scenarios.



**Figure 3:** Training on Simple Data Analysis and Logical Functions

The training program culminated in a module on data visualization. The goal of this final section was to equip participants with the skills to present data in an effective, communicative, and visually compelling manner. Participants were introduced to a portfolio of common chart types, including bar charts, line charts, and pie charts. More importantly, they were taught the principles behind selecting the appropriate chart type to match the data's characteristics and the intended narrative. This module aimed to transform their ability to handle data from mere analysis to effective storytelling, a critical skill in any data-driven field.



**Figure 4:** Data Visualization and Communication Techniques

### 3.2. Survey Analysis

Analysis of the survey reveals several key insights regarding the training on software usage (like Excel) for mathematical problems. The questionnaire was administered using a combination of open-ended and closed-ended questions. For the closed-ended questions, participants were given five response options representing their level of agreement (in this case, 1=Strongly Disagree, 5=Strongly Agree). The complete questionnaire form can be seen in Appendix 3, and the results can be viewed in Appendix 4.

Figures 5 and 6 present a series of ten bar charts that display the survey results concerning respondents' perceptions and understanding of mathematics and its applications, likely from before and after the training. In general, the data indicate a very positive response from the participants. There was a very high level of agreement (a majority selected a score of 5 or "Strongly Agree") for statements regarding the benefits for further study, the importance for the professional world, and the understanding of different chart types. This indicates that respondents see clear value in the material that was taught for their future endeavors.

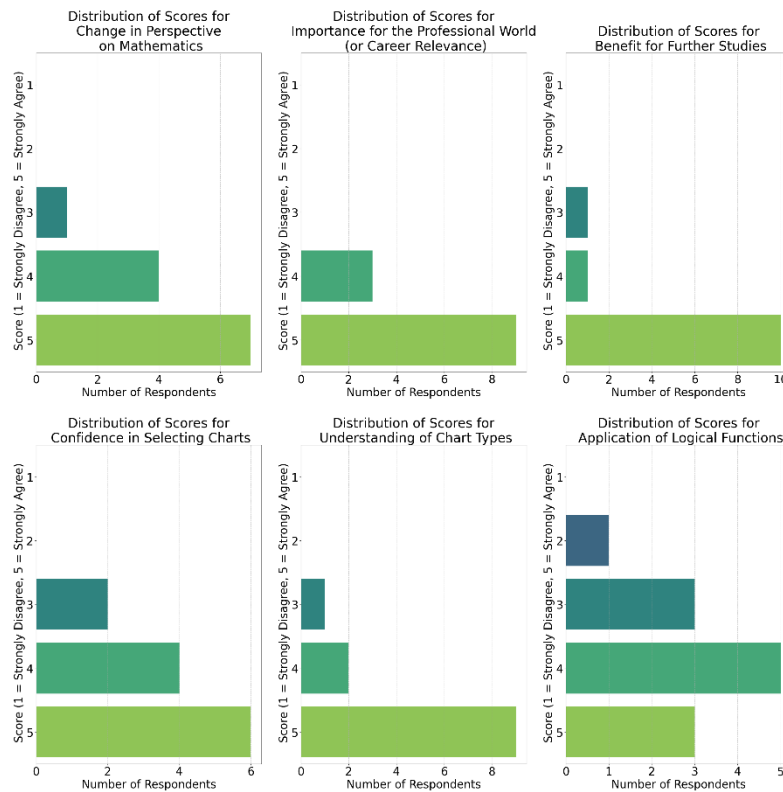


Figure 5: Feedback

Furthermore, Figures 5 and 6 also show a marked increase in confidence and understanding across various areas. Although some variations exist, the majority of respondents agreed (scores of 4 or 5) that their perspective on mathematics had changed, and that they now better understand and feel more confident in applying basic concepts, using logical functions, and selecting appropriate charts. In comparison, the scores for "Confidence Before Training" tended to be lower (centering around 3 and 4), while the scores for understanding and confidence after the training were significantly higher. This strongly implies that the training was successful in enhancing the confidence and competence of the participants.

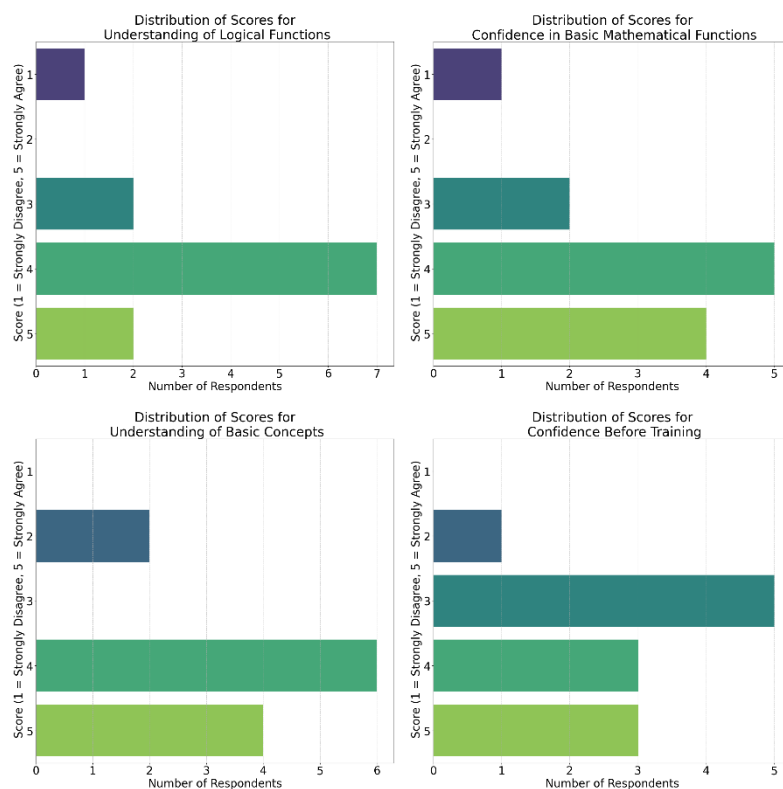


Figure 6: Feedback (continued)

Several respondents highlighted "materials 1 & 3" and "How to use count, and also how to choose the right chart to present data" as particularly enlightening moments. This suggests that the introductory material and the data visualization module were highly impactful. Others mentioned "creating columns for data presentation because it is easy to understand and digest" and "the Charts section (bar, line, circle)," which reinforces that the practical and visual aspects of the training were highly valued. One respondent simply noted "the theory," which may indicate that the clear theoretical explanations were also an important component.

**Challenges Encountered** The most frequently cited challenges were "The variety of formulas" and the logical functions "if, countif, sumif." This confirms that logical functions and the complexity of formulas were the primary obstacles for participants. Other respondents mentioned challenges with "the MAX [function]" and "the calculating part," which may point to difficulties in understanding the syntax or logic behind certain functions. Challenges described as "the data" and "a bit of lag haha" suggest issues related to handling the provided datasets and possibly software performance.

**General Feedback and Suggestions** Some respondents provided positive general feedback, such as "none because it was very fun and I learned a lot" and "nothing, this was already good," indicating overall satisfaction. An interesting suggestion was, "The MC should be more lively to build excitement," which indicates that a more energetic and interactive atmosphere could further enhance the learning experience. No other specific suggestions for improvement were offered, which may suggest that participants found the training to be comprehensive and were satisfied with its content and structure.

#### 4. Conclusion

The community service program aimed at enhancing data literacy and Microsoft Excel skills among students of SMAS Sebelas Maret Bandung successfully achieved its primary objectives. The training demonstrably improved the participants' confidence and competence in fundamental data processing, as evidenced by overwhelmingly positive survey feedback and a significant increase in self-assessed skills post-training.

The program's key successes were observed in the foundational and data visualization modules (Module 1 and 3), where participants showed high levels of engagement and understanding. However, a critical finding of this initiative was the identification of the "Data Analysis & Logical Functions" module (Module 2) as the most significant challenge for the students. While the program was well-received overall, participant feedback also indicated that the learning experience could be enhanced with a more dynamic and interactive atmosphere.

In summary, this program not only succeeded in delivering essential digital skills but also provided valuable pedagogical insights. It confirmed the effectiveness of hands-on training for introductory and visual topics and highlighted specific areas where future workshops can be refined for greater impact.

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#### References

- Bhargava, R. (2019). Data Literacy. In *The International Encyclopedia of Media Literacy* (pp. 1–5). John Wiley & Sons, Ltd. <https://doi.org/https://doi.org/10.1002/9781118978238.ieml0049>
- Ercegovac, Z. (2015). Data-Driven Society Begins with Data-Savvy Youth. *Bulletin of the Association for Information Science and Technology*, 42(1), 42–48. <https://doi.org/https://doi.org/10.1002/bul2.2015.1720420111>
- Formby, S. K., Medlin, B. D., & Ellington, V. (2017). Microsoft Excel®: Is It an Important Job Skill for College Graduates?. *Information Systems Education Journal*, 15(3), 55–63.
- Griffin, G. W., & Holcomb, D. (2023). Data Literacy and Skills Development. In *Building a Data Culture: The Usage and Flow Data Culture Model* (pp. 109–122). Apress. [https://doi.org/10.1007/978-1-4842-9966-1\\_6](https://doi.org/10.1007/978-1-4842-9966-1_6)
- Jeong, J., & Lee, Y. (2024). Development of Data Literacy Competency System for K-12. *International Journal on Advanced Science, Engineering and Information Technology*, 14(6 SE-Articles), 2130–2140. <https://doi.org/10.18517/ijaseit.14.6.12373>
- Kuka, S., & Karamani, B. (2011). Using Excel and VBA for Excel to learn numerical methods. *1st International Symposium on Computing in Informatics and Mathematics*, 365–376.

- Leon-Urrutia, M., Taibi, D., Pospelova, V., Splendore, S., Urbsiene, L., & Marjanovic, U. (2022). Data Literacy: An Essential Skill for the Industry. In B. Lalic, D. Gracanin, N. Tasic, & N. Simeunović (Eds.), *Proceedings on 18th International Conference on Industrial Systems -- IS'20* (pp. 326–331). Springer International Publishing.
- Liengme, B. V. (2000). A guide to Microsoft Excel for business and management. (*No Title*).
- Miloradov, M., Rakic, S., & Marjanovic, U. (2022). Towards digital economy through data literate workforce. *Companion Proceedings of the Web Conference 2022*, 417–422. <https://doi.org/10.1145/3487553.3524696>
- Mustafy, T., & Rahman, M. T. U. (2024). Excel. In *Statistics and Data Analysis for Engineers and Scientists* (pp. 81–134). Springer.
- Simaremare, S., & Siregar, R. (2024). Effectivity of the Microsoft Excel Application on Student Understanding in Statistics Courses. *Indonesian Journal of Education and Social Humanities*, 1(2), 9–19.
- Talib, Y. Y. A., & Mohamad, R. (2020). *Microsoft Excel: Preparing Data, Analysing Data and Designing a Business Model—A Practical Guide* (UUM Press). UUM Press.