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Improving Teachers' Data Visualization Skills Using Microsoft Excel to Support SDG 4

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ABSTRACT

Objective: *The community service program aims to improve teachers' knowledge and skills in data visualization using Microsoft Excel to support effective data management and evidence-based educational decision-making in the digital era, in line with SDG 4 (Quality Education).* ***Method:*** *The program was implemented through hands-on training for teachers at Fajrul Karim Islamic Boarding School, Serang, Banten. The training combined lectures, demonstrations, guided practice, and discussions. The learning materials included data organization, descriptive statistics, pivot tables, and chart creation using Microsoft Excel. Participants practiced applying these features to analyze and visualize student assessment data.* ***Results:*** *The training successfully enhanced participants' understanding and practical skills in organizing, analyzing, and visualizing educational data using Microsoft Excel. Teachers were able to transform student assessment data into informative visual representations, enabling them to interpret learning outcomes more effectively and support data-driven educational practices. Participants also demonstrated improved confidence in utilizing Excel for routine academic data management.* ***Novelty:*** *The program integrates statistical data analysis and visualization techniques into Microsoft Excel training specifically designed for teachers in an Islamic boarding school setting. The combination of practical statistical applications and digital literacy development provides an effective approach to strengthening teachers' competencies in educational data management and supports the implementation of quality education through technology-based capacity building.*

INTRODUCTION

Excel is a number processing software that is quite popular because it has complete features (Chen et al., 2024; Mafarja et al., 2023; Mustafy & Rahman, 2024; Plauska et al., 2022). Various types of calculation and data processing processes can be done quickly using Excel, including creating diagrams and graphs in data visualization (Healy, 2024; Kharakhash, 2023; Schwabish, 2023). Excel dashboards can be created from a combination of diagrams, graphs and readily available tools (Alexander, 2022; Apellániz et al., 2024; Schroeder et al., 2022). Dashboards can help users display data, from simple tables to displays that are visually attractive and have clear meaning for readers Physics is a complex and difficult science, so innovative strategies are needed to increase students' interest in learning physics.

Data visualization is used to display data in an interesting, interactive way without leaving out information (Aigner et al., 2023; Korkut & Surer, 2023; Steed, 2025). Data visualization uses visual elements such as charts, graphs and maps to represent data into information (Berinato, 2023; Wong, 2023). It shows trends, patterns, and outlines in the data. Information can be conveyed more easily with this method. An organization with large data collections needs a method to make it easier to read and analyze it. Visualization is the transformation of data into visual form (tables or graphs) so that the

characteristics of the data and the relationships between data elements or attributes can be analyzed or reported (Shakeel et al., 2022; Shete & Khobragade, 2023).

Data visualization is one of the best and most interesting techniques for data exploration. Humans have the ability to analyze large amounts of information presented visually (X. Fu et al., 2024; Theeuwes et al., 2022). Meanwhile, data visualization is defined by various types of ways to create images, graphics or animations with the aim of communicating a message/information (Hall & Dávila, 2022; Veglis, 2022; Waugh et al., 2025). In general, visualization is used to collect very large amounts of data which is then presented using various models.

Data visualization is nothing new, visual communication has existed in various forms for hundreds of thousands of years. The most popular techniques such as tables, lines, bars, pies and graphs originated in the 18th century (Ruokkeinen et al., 2024; Tuscher et al., 2025; Vázquez, 2024). The part that continues to develop and is considered new is the taste and interest in data visualization. The main goal of data visualization is the ability to visualize data, communicate information clearly and effectively. Abundant data in an agency will become useless if there is no good management and optimal utilization (Kamyab et al., 2023; Morera-Pujol et al., 2023).

Data visualization is defined as a form used to explore data, understand data, and communicate data (Yau, 2024). Becomes a means for conducting data analysis so that it can make it easier to obtain understood meaning and then communicate it back to the users. Many Excel users, including teachers, have not been able to optimize their use of Excel (Damjanovic & Katanic, 2023). Therefore, it is hoped that this Excel training can help the community, especially teachers at the Fajrul Karim Islamic boarding school.

RESEARCH METHOD

Excel training for teachers at the Fajrul Karim Islamic boarding school was held on May 17 2024 in the Computer Lab Room at the Fajrul Karim Islamic Boarding School. Participants follow and practice Excel. The method used in this training is an interactive method, class discussions and directly solving problems presented in the form of student score data that must be completed and analyzed. In addition, participants are given the opportunity to provide assistance if they want to learn and consult by providing communication media via email or WhatsApp. The training is divided into two main topics. The first topic is data management, including organizing data, descriptive statistics, using Excel tools, and pivoting. The second topic is data visualization, including an introduction to charts in Excel, how to create charts, and analysis. Using the appropriate method, it is be suggested to describe the participant, the instrument, the data collection, and the data analysis.

Organizing data includes using tables, operations in tables, and summaries. Introduction to measurement scales in statistics, namely nominal, ordinal, interval and ratio scales (Jideani et al., 2024; Mbanaso et al., 2023; Saneii & Doosti, 2024). Furthermore, descriptive statistics material includes measures of centering (mean, median, mode) and distribution of data (range, variance, standard deviation) as well as appropriate functions to obtain these measures in Excel (Chattamvelli & Shanmugam, 2023; Choudhry et al., 2024). Participants are also guided to activate and use the Data Analysis tools in Excel which have features for data analysis, including descriptive statistics. Data visualization, including an introduction to charts in Excel, how to create charts, and analysis (Skender & Ali, 2022). Several types of diagrams that are often used and choosing a suitable diagram. In this session, several tips were also presented on how to make diagrams so that they are easy for other people to read. The next material is pivots which include Pivot Tables and Pivot Charts.

Evaluation of training results is carried out after carrying out the training. Evaluation is given by providing post test exercises so that it can be seen what percentage of participants have understood the material well or not. Apart from that, a questionnaire is given which can be used to evaluate the management of training implementation. The questionnaire includes participants' opinions regarding the usefulness of the training material, clarity in delivering the material, supporting facilities such as modules and consultation assistance, as well as training management. At the end of the questionnaire, participants can provide input or criticism on training management.

RESULTS AND DISCUSSION

Results

Excel training was held on July 17 2024 at the Fajrul Karim Islamic Boarding School in Serang, Banten. The activity was attended by middle and high school teachers at the Fajrul Karim Islamic Boarding School, Serang, Banten. The training materials and data used were provided before the implementation day. Total training participants were 20 participants.

Apart from using pie charts, participants may also replace them with other diagrams that are also suitable for the data, for example bar charts. Participants can also change the colors according to the desired theme. Apart from that, if you use pivot, participants can also take advantage of the Slicer or Timeline feature as a tool for selecting data to display. Participants can also directly copy the diagram from the pivot chart and use the filters that are available on the diagram. Because not all data can be used for the Slicer and Timeline features, participants need to pay attention to the structure of the data they have.

Participants were given a questionnaire after the training via Google Form as an evaluation of the implementation of the activity. Of all activity participants, 67.5% had used the Excel program package for learning, processing, doing assignments and other purposes. The training facilities provided at the training (material files, certificates, etc.) were 89% adequate. The presentation of the training material is quite clear and can be followed well as much as 75.75% of the time and there are obstacles in carrying out data analysis and data visualization as much as 43%. As a follow-up, even though the training has been completed, the team facilitates all participants if anyone wants to ask questions regarding the material. In addition, almost all participants, 98%, stated that the training activities were useful for increasing insight into the use of Excel for teachers at Islamic boarding schools and hoped that there would be further training on more advanced topics.

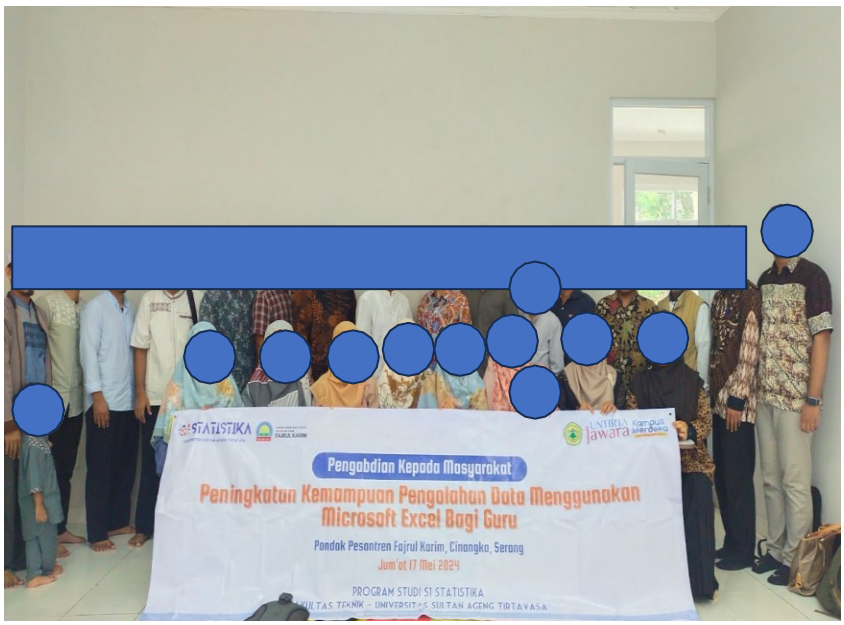

Figure 1. Training participants and statistics lecturers at Sultan Ageng Tirtayasa University

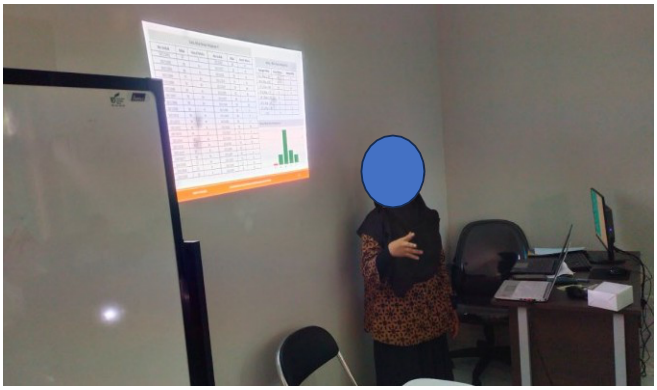

Figure 2. The speaker delivers visualitation data

Co-Occurrence with Keywords Plus for creative thinking in physics education consisting of Sources (Journals, Books, etc.) totaling 36 articles. With Keywords Plus (ID), creative thinking, and physics education, as many as 212. The total number of Authors from 1959-2023 was 138, and the Authors of single-authored documents were nine authors. The results of the top ten-word cloud about creative thinking and physics education from the most to the lowest consist of the words students as many as 14, engineering education as many as 7, teaching as many as 4, while e-learning, Likert scale, professional aspects, and computer software as many as 3.

Figure 3. Discussion and data visualization case study

Discussion

The findings demonstrate that Microsoft Excel training effectively improved teachers' competencies in educational data management and visualization. Most participants successfully applied the concepts introduced during the training, including data organization, descriptive statistics, pivot tables, and chart creation. The high level of participant engagement throughout the training indicates that practical, hands-on learning activities can effectively enhance teachers' digital literacy and confidence in utilizing spreadsheet applications for educational purposes. These findings are consistent with previous studies reporting that technology-based professional development programs strengthen teachers' digital competencies and improve their ability to make data-informed instructional decisions.

The evaluation results further reveal that the training was positively perceived by participants. Most teachers considered the training materials, facilities, and delivery methods to be clear and relevant to their professional needs. Although a proportion of participants still experienced difficulties in conducting data analysis and visualization, the availability of post-training assistance enabled continuous learning and problem-solving. This finding suggests that professional development programs should not only focus on one-time workshops but also provide ongoing mentoring to ensure the successful implementation of newly acquired digital skills. Continuous support is essential for helping teachers integrate Microsoft Excel into routine educational administration and classroom assessment.

From a broader perspective, the training contributes to strengthening evidence-based educational practices by enabling teachers to transform raw student assessment data into meaningful visual information. Effective data visualization facilitates the identification of learning trends, supports more accurate academic decision-making, and improves the quality of educational management. These outcomes align with the objectives of SDG 4 (Quality Education), which emphasizes improving teacher capacity through technology integration and digital literacy. Therefore, similar training programs should be expanded to other schools and educational institutions to promote sustainable professional development and support data-driven educational innovation.

CONCLUSION

Fundamental Finding: The community service program successfully improved teachers' knowledge and practical skills in using Microsoft Excel for data analysis and visualization. Teachers at Fajrul Karim Islamic Boarding School actively participated in the training, demonstrated a clear understanding of the presented materials, and were able to apply statistical methods, pivot tables, and chart features to visualize student assessment data. The resulting visualizations enabled participants to interpret educational data more effectively and supported better understanding of students' learning outcomes. **Implication:** The findings indicate that Microsoft Excel training is an effective strategy for strengthening teachers' digital competencies and promoting data-driven educational practices. The ability to organize, analyze, and visualize student data enables teachers to make more informed instructional and academic decisions. This program also contributes to the achievement of SDG 4 (Quality Education) by enhancing teachers' digital literacy and capacity to utilize technology in educational management. **Limitation:** This program was implemented in a single Islamic boarding school with a limited number of participants. Therefore, the outcomes may not fully represent teachers in different educational institutions or regions. In addition, the evaluation focused primarily on participants' immediate learning outcomes without assessing the long-term implementation of the acquired skills. **Future Research:** Future community service programs and studies should involve a larger number of schools and participants from diverse educational settings. Further research is recommended to evaluate the long-term impact of Microsoft Excel training on teachers' professional performance and to integrate more advanced data analytics and visualization tools for educational decision-making.

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AUTHOR CONTRIBUTIONS

Faula Arina contributed to the conceptualization of the community service program, project design, methodology development, supervision, manuscript drafting, and project administration. **Mukhtar** contributed to the development of the training materials, implementation of the training sessions, data collection, and validation of the program outcomes. **Rafli Priyantama Ramadhan Bagaskara** contributed to participant assistance, data analysis, preparation of Microsoft Excel training modules, and manuscript editing. **Syukron Faiz** contributed to the investigation, documentation of program activities, evaluation of participants' learning outcomes, visualization of the results, and manuscript review. **Muhammad Fabian Reinhard Delano** contributed to data management, technical support during the training, interpretation of the findings, language editing, and final proofreading of the manuscript. All authors have read, reviewed, and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors acknowledge the use of digital tools, including AI-based technologies, as support during the research and writing process of this article. Specifically, AI-based language assistance tools were used for improving grammar, language clarity, and manuscript organization. ANSYS software was employed for numerical simulation and structural analysis of the floating fiber embankment model. All outputs generated with digital assistance were critically evaluated, verified, and revised by the authors to ensure academic rigor, accuracy, and compliance with ethical publication standards. The final responsibility for the content, interpretation, and conclusions of this manuscript rests entirely with the authors.

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