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The positive impact of Telegram bot usage on supporting students' learning processes and outcomes during on-the-job training

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Abstract

This study explores the impact of using Telegram bots on student learning outcomes during the on-the-job training program for XI Software Engineering and Game Development program (PPLG) students in the 2023/2024 even semester, during which students missed direct learning. Using a quantitative correlation approach, data were collected through questionnaires, Telegram bot usage, and learning outcomes. The study involved 71 students from two XI PPLG classes, selected through saturated sampling. Data were analysed using normality, linearity, hypothesis tests, and Pearson product-moment correlation with SPSS 26. The results show a significant relationship between Telegram bot usage and learning outcomes, with a correlation of 0.821 (very strong, sig = 0.000 < 0.05). These findings suggest a potential for developing blended learning models that integrate Telegram bots during the on-the-job training program for students.

INTRODUCTION

The advancement of technology enhances learning by making it more engaging, accessible, and flexible. Digital tools like educational apps and communication platforms boost student motivation and interaction with learning materials. Research shows that interactive media foster enthusiasm for learning (Munawir *et al.*, 2024), while technology expands access, presents content dynamically, and enhances student engagement (Widayat *et al.*, 2024). By simplifying information access and creating a more dynamic learning environment, technology plays a crucial role in modern education. Welong *et al.* (2022) found that the consistent use of high-quality digital learning resources positively impacts student achievement, whereas inadequate resources can have negative effects on learning outcomes.

Technological advancements have various applications that support the learning process, one of which is the Telegram application. Telegram is a messaging service that operates in real-time across mobile, desktop, and web platforms. Ermawati and Hasanudin (2021) stated that one of the key innovations supporting learning during the COVID-19 pandemic was the use of Telegram. Mohammed *et al.* (2024) found that integrating Telegram into education enhances student engagement and facilitates collaborative learning. Similarly, Sudiatmika and Dewi (2021) highlighted that the Telegram chatbot allows teachers to upload materials and announcements, assign tasks, and download student responses. These findings underscore the significant potential of technology, particularly social media platforms like Telegram, in enhancing learning quality and fostering a more dynamic and interactive educational environment.

The Telegram application offers various features, one of which is the Telegram bot. Theoretically, Telegram bots have the potential to support independent learning, as highlighted in research by Subiyantoro and Listyaningsih (2020). Their study outlines several advantages of using

Telegram bots as a learning medium, including: (1) compatibility with multiple operating systems such as Android, iOS, and Windows; (2) free access without a subscription; (3) support for multimedia content; (4) fast synchronization; (5) the ability to present exercises for both individual and group learning; (6) rapid system response within seconds; and (7) flexibility in using learning media both inside and outside the classroom. Given these advantages, this study utilizes the Telegram bot as a learning resource and a platform for storing educational materials, particularly in graphic design subjects.

At the elementary level, Telegram bots have been used to support learning, with studies demonstrating their effectiveness in improving students' understanding and achievement. For example, Aisyah *et al.* (2021) and Syifa (2022) highlighted the success of Telegram bots containing e-learning modules. Similarly, Rohmah (2023) developed a bot-based science learning tool integrated with Islamic values, proving to be valid, practical, and effective. Pratama (2021) created a bot focused on Nusantara traditional house materials, also found to be suitable for use. Oktaladi *et al.* (2022) introduced MIBOTER, a Telegram bot for Islamic religious subjects, which allows easy access to materials anytime, anywhere, and supports repeated study.

At the junior high school level, research has also been conducted on the use of Telegram bots for science subjects, such as the study on substance pressure by Nihayati *et al.* (2022), which was proven to be feasible for application in learning and received enthusiastic responses from students. According to Safitri and Lubis (2022), the development of teaching materials on fable texts with the help of Telegram bots was tested and found suitable for use. Similarly, Yulianti *et al.* (2021) developed learning media using the Telegram bot application for Integrated Social Studies, and their research confirmed that it was a feasible learning tool. Several studies on Telegram bots at the junior high school level focus on their development in specific subjects and have proven them to be effective and suitable for use in education.

At the high school level, research on Telegram bots was conducted by Saputri *et al.* (2023), who produced a teaching media product based on Telegram bots, which was tested and found feasible for use in Economics subjects, specifically Fiscal and Monetary Policy materials. Additionally, Subiyantoro & Listyaningsih (2020) developed Telegram bot-based learning media, stating that the use of Telegram bots not only offers innovative and concrete visualization of knowledge but also makes mobile learning media highly feasible. Similarly, Oktavia & Sriyono (2022) demonstrated a significant difference in post-test scores between students who used a Telegram bot and those who did not, proving that Telegram bots are effective in the learning process, particularly in teaching atmospheric material and improving student learning outcomes.

At the vocational school level, Nuryunia & Suprihatin (2022) developed a Telegram bot for teaching fashion parts, which was found suitable as a learning medium. Pradiktya (2022) also created a Telegram chatbot for teaching algorithmic materials, demonstrating its effectiveness in enhancing student knowledge. Additionally, Telegram bots are used as notification media, as shown by Agusman *et al.* (2023), who used them to alert server administrators of potential issues. Putra & Dermawan (2021) also highlighted the effectiveness of learning media in improving student outcomes in computer and network subjects. Anggraini & Wibawa (2019) found that using Telegram as a learning medium improved student outcomes in video processing engineering. These studies demonstrate that Telegram bots positively impact learning outcomes, both as subject-specific tools and notification media.

Although several studies have explored the development and effectiveness of Telegram bots as learning tools (e.g., Saputri *et al.*, 2023; Subiyantoro & Listyaningsih, 2020; Anggraini & Wibawa, 2019), a key gap remains in understanding how Telegram bots directly impact student learning outcomes, particularly during on-the-job training programs in vocational schools. While Telegram has been shown to have a positive effect on student achievement, there is limited research on how these bots influence the performance of students specifically engaged in long-term on-the-job training in vocational school settings. This gap highlights the need for further

investigation into the relationship between Telegram bot usage and measurable improvements in learning outcomes in this specific context.

The preliminary research conducted at a vocational school showed that the implementation of the student internship or on-the-job training program in the even semester, which lasted for three months, required students to study independently during that period. At one school in Semarang, located in the city centre, an interview with a Graphic Design teacher revealed concerns about the impact of on-the-job training on student learning outcomes. To address this challenge, Telegram bots were introduced and began being used at the start of the even semester in the 2023/2024 school year, with the hope of positively impacting student learning outcomes. Therefore, this vocational school is suitable for the purpose of this study.

This study aims to investigate the impact of Telegram bots on student learning outcomes during the on-the-job training (OJT) program in vocational schools, particularly in the context of independent learning during internships. The urgency of this research stems from concerns raised by educators about the potential negative effects of OJT on student performance. By introducing Telegram bots as a learning tool, the study seeks to explore how these bots can enhance student engagement and learning outcomes during a period of limited direct instruction. The potential contribution of this study lies in providing valuable insights into the effectiveness of Telegram bots as an innovative learning resource in vocational education, particularly for students undergoing long-term OJT.

LITERATURE REVIEW

A. Usability and ease of use of technology

The usability of learning media is defined as the extent to which a system user can operate a particular system with minimal effort and simplicity (Al-Rahmi *et al.*, 2021). According to Min *et al.* (2019), ease of use refers to how easy it is to understand and use a system. This can be achieved through specialized software, websites, machines, processes, or any other means that facilitate user interaction. The perception of ease of use reflects how users believe technology can be used without requiring significant effort. In the context of social media, if users perceive it as easy to learn, access, and use, they are more likely to accept and adopt it.

Building on these concepts, usability, distinct from user satisfaction and experience, also considers user convenience. It reflects how users believe that technology will enhance their performance, productivity, or effectiveness in completing tasks. In the context of social media, if users perceive that it helps with learning, sharing information, collaborating, or achieving other learning goals, they are more likely to accept and adopt it. By contextualizing the factors of usability and ease of use in the learning environment, the following (Table 1) results were obtained.

Table 1 Related keywords

No.	Usefulness	Ease of use
1.	Learn faster	Easy to Learn
2.	Improved learning outcomes	Controllable
3.	Increased learning activity	Clear and understandable
4.	Effectiveness	Flexible
5.	Making learning easier	Easy to become skilled
6.	Useful	Easy to use

The usability factors in Table 1 are derived from the Technology Acceptance Model (TAM), developed by Davis (1989). TAM measures the acceptance and use of technology, including social media, based on users' perceptions of its usefulness and ease of use. TAM has been widely adopted and tested in various contexts, such as information systems, mobile technology, e-commerce,

and more. This model has proven effective in predicting and explaining user behaviour towards technology adoption. By understanding the factors that influence technology adoption, organisations can design and implement technologies that better meet the needs and preferences of users. Therefore, this study uses a modified version of the TAM theory to assess the use of Telegram bots as digital learning resources. The study examines how students' use of Telegram bots is influenced by their perceptions of usefulness and ease of use. Social media's usability and ease of use in education can serve as a theoretical foundation for developing research instruments.

B. Telegram bots as a learning resource

In today's rapidly advancing digital age, information and communication technology has transformed how people access information and engage in learning. This digital shift has significantly influenced the learning resources used in education. Ismaniati and Dopo (2016) define digital learning resources as a combination of hardware and software components designed to address learning challenges and support educational activities.

Digital learning resources encompass materials, media, or tools that are developed or accessed via digital technology. In this study, digital learning resources refer to educational tools managed through technology, specifically using the Telegram application's Telegram bot feature. This allows students to access learning materials or resources at any time. Terms such as electronic books, e-libraries, and e-modules have contributed to the growth of digital-based learning (Emalia and Farida, 2019). When used consistently, digital learning resources positively impact learning. Welong *et al.* (2022) note that higher-quality digital learning resources can enhance student performance, while insufficient resources can lead to diminished student achievement. Therefore, digital learning resources must be fully utilized to improve learning outcomes and enrich the learning experience of digital-native students (Exodus & Siwi, 2020).

The use of digital learning resources has had a profound effect on education. Mhouti *et al.* (2013) identified key components and criteria for evaluating digital learning resources, one of which is the technical quality aspect. The design, visual presentation, and auditory features of digital learning resources can impact the material's aesthetics and pedagogical effectiveness (Mhouti *et al.*, 2013). As a result, this study considers the display aspect of Telegram bots as part of the research instrument. The visual display of the Telegram bot includes the presentation of learning media such as YouTube, PowerPoint, or other educational materials.

According to Tompo (2018), a bot stands for "robot," which is created by humans (programmers) to help people with tasks they perform daily. These bots are called "Telegram bots" when used within the Telegram social media app. Telegram bots can also be considered a form of digital media. According to Muammar and Suhartina (2018), there are several indicators of digital learning media, such as improving student understanding, making data engaging and reliable, facilitating data interpretation, and condensing information. The use of Telegram bots in learning leverages the latest technology, which is popular among students, and can increase their interest and participation in learning.

As evidenced by Putra & Dermawan (2021), Telegram bots can also incorporate technological elements such as gamification or animation, making learning more engaging and interactive. Telegram bots qualify as learning media because they assist in the learning process. Teachers can input subject matter or assessments into a Telegram bot, which students can access through their mobile phones. This enables a pattern of interaction between teachers and students through mobile phones, taking place within the network. These interactions occur in real-time within the Telegram platform, allowing for more effective and efficient distance learning.

C. Graphic design subject

In the context of vocational schools, the subject of Graphic Design is one of the 20 skills provided by the government through the Ministry of Education, Culture, Research, and Technology. This subject is designed to teach students fundamental graphic design skills that can be applied in everyday life and prepare them for careers in the workforce or starting their own businesses. The intended learning outcomes of the Graphic Design subject are to equip students with both technical (hard) skills and personal (soft) skills necessary for the professional world. This aligns with the Pancasila Student Profile, which emphasises qualities such as faith, fear of God Almighty, noble character, critical thinking, independent creativity, discipline, and cooperation (Badan Standar Kurikulum dan Asesmen Pendidikan, 2022).

As outlined in the Badan Standar Kurikulum dan Asesmen Pendidikan Decree (2022), vocational school students in grades XI and XII (typically around 16-18 years old) are expected to achieve various competencies. These include implementing Occupational Health and Safety (K3), preparing graphic design equipment and materials, identifying tools and materials for graphic design production, understanding the concepts behind design illustrations using vector drawing software and image editing, and creating such illustrations. Additionally, students should be able to create indoor print media product designs and design year-end books and promotional print media. They will also learn to implement procedures for exhibiting their design works and presenting print media designs at exhibitions. Furthermore, students will be required to identify necessary final touch-ups and produce reports on the results of their graphic design projects in line with standard procedures.

In this study, the focus of graphic design learning in class XI PPLG is on print media materials used to assess students' skills. The knowledge domain is evaluated based on all the material covered during the course. Student learning outcomes are measured through two key components: reflecting understanding and practical graphic design skills. The first component is the project grade, which evaluates students' ability to create print media designs using industry-standard software such as Adobe Photoshop or CorelDRAW. This assessment gauges their technical proficiency with the software and their ability to apply design principles and creativity in real-world contexts. The second component is the final assessment, scheduled for June 2024, which aims to assess students' overall understanding of the course material. The questions in this assessment are aligned with the content provided in the Telegram bot, ensuring that students' knowledge is evaluated concerning the material covered throughout the course.

METHOD

The method used in this study is quantitative correlation. Based on the nature of the research problem, this study is classified as correlation research, aiming to determine whether or not there is a relationship between variables. The research strategy employed is a symmetrical relationship, which refers to the relationship between two or more variables that occur simultaneously (Sugiyono, 2019). The research method involves distributing questionnaires via Telegram bots and measuring student learning outcomes through project skill scores in print media design and final semester assessment scores in the Graphic Design subject.

The population in this study consists of 71 students (n=71) from two classes in the Software Engineering and Game Development study programs in grade XI for the 2023/2024 academic year. According to Arikunto (2017, 173), the sample is determined based on the number and characteristics of the population. If the subjects are fewer than 100, the research sample includes the entire population; however, if the subjects exceed 100, a sample of 10-15% or 15-25% of the population can be selected. In this study, since the population is less than 100 respondents, the author has selected 100% of the population, consisting of 71 students in grade XI PPLG. Therefore, the entire population is used without drawing a sample, a method known as a saturated sample.

The data collection technique in this study used a questionnaire with a Likert scale of 1-5, tests, and documentation. The questionnaire on the use of telegram bots has been tested for validity and reliability. However, the limitation of this study is that the learning outcomes are not tested for validity and reliability because teachers of Graphic Design subjects explicitly develop the project assessment instruments and final assessment grids by ensuring compatibility with the learning materials in the Telegram bot and learning outcomes.

The data in this study were collected through questionnaires and student learning outcomes. The questionnaire used in this study was a closed-ended questionnaire with a 5-point Likert scale. Student learning outcomes were obtained from skill scores related to designing print media and final assessment scores. Teachers of Graphic Design subjects developed assessment instruments and grids. This research instrument was designed based on relevant theories for each variable, ensuring construct validity. The following is a grid of instruments used in this study.

Table 2 Research instruments

Variable	Aspects	Instruments
Telegram Bot Usage	Learning Objectives Material Display Ease Usability	Questionnaire using Likert scale 1-5 with a statement from strongly agreeing to strongly disagreeing
Learning Outcomes	Print Media Design Project Value End of Semester Assessment Score	Design project assessment instrument Grid of end-of-semester assessment questions

The methods used in this study include descriptive statistical analysis to process the obtained data. Before the analysis, prerequisite tests were performed, including a normality test to determine whether the data followed a normal distribution and a linearity test to assess the linear relationship between variables. This study involves two variables: the independent variable, which is the use of Telegram bots, and the dependent variable, which is student learning outcomes. The results of the normality and linearity tests confirmed that the data were usually and linearly distributed. Consequently, hypothesis testing was conducted using the Pearson product-moment correlation test to examine the relationship between the two variables and the coefficient of determination test to measure the extent of variability in the data. Conducting a series of analyses is hoped to provide a deeper understanding of the observed data and answer the research questions asked.
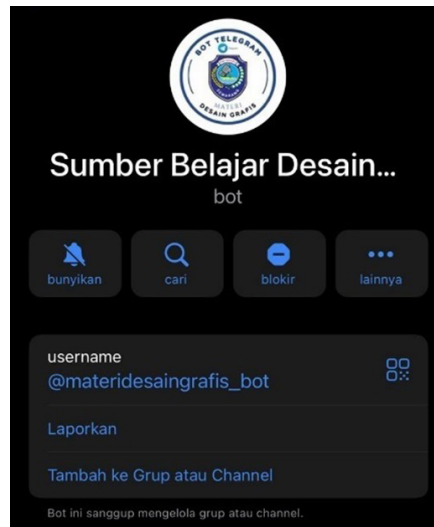
RESULT AND DISCUSSION

At the beginning of the even semester of the 2023/2024 academic year, the re-searcher introduced a learning innovation in the Graphic Design subject. This inno-vation involved the development of a Telegram bot as a learning resource to improve accessibility and facilitate learning. Designed to offer students educational materials and interactive tutorials, the bot incorporates digital technology into education, par-ticularly in fields requiring quick and easy information access. Additionally, it demonstrates the potential for collaboration between higher education institutions and secondary schools to enhance learning quality. The bot provides access to PPT and PDF learning materials, Graphic Design concepts and editing software tutorials. Grade XI PPLG students first utilised it during the even semester of 2023/2024, as they had previously been engaged in on-the-job training and had to study inde-pendently for three months.

Implementing the Telegram bot to support student learning during their on-the-job training program required all XI PPLG 1 and XI PPLG 2 students to download and log in to the Telegram application before accessing the Graphic Design subject bot. They could do so via a link

provided by the teacher or by searching for "Graphic Design Learning Resources/@materidesain-grafis_bot" in the search bar.

Figure 1 Telegram bot profile display graphic design

The results and discussion are structured into three key sections. *First,* the Data Description provides an overview of the collected data, offering insights into its characteristics. *Second,* the Data Analysis Prerequisite Test Results present the outcomes of tests conducted to ensure the data meets the necessary assumptions for further analysis, such as normality and linearity. *Finally,* the Hypothesis Test Results evaluate the relationship between variables using statistical methods, determining the significance and strength of their correlation.

A. Data description

According to Sugiyono (2019), descriptive statistics involves analyzing data by first summarizing and organizing the information collected from each variable. This process helps to present the data in a clear and understandable manner, allowing for an in-depth description of its characteristics. Once the data has been organized, the next step is to interpret the findings and draw conclusions based on the patterns or trends observed. The ultimate goal of descriptive statistics is to provide a comprehensive overview of the data, making it easier to identify key insights and communicate meaningful interpretations.

According to Table 3, the data analysis highlights the effectiveness of Telegram bots as a learning resource in Graphic Design education. Student scores for Variable X ranged from 167 to 236, with a mean of 203.63, and 32% of students (most of the students) rated it in the "good" category, indicating positive reception. For Variable Y, learning outcomes ranged from 78 to 93, with a mean of 85.34, and 18% of students (most) fell into the "good" category, suggesting a positive impact on performance. These findings confirm that integrating Telegram bot enhances accessibility and supports student learning effectively.

The findings suggest that implementing Telegram bots as a learning resource in Graphic Design education has been generally effective. Most students rated the bot positively (Variable X), with most falling into the "good" category, indicating that they found it useful and accessible. Additionally, student learning outcomes (Variable Y) were also categorised as "good," suggesting a positive correlation between the use of the bot and student performance. The statistical results reinforce this conclusion, as both variables show relatively high average scores and a concentration of students in the middle-to-upper performance range. This implies that integrating digital tools like the Telegram bot can enhance learning engagement and outcomes, particularly in subjects that require quick access to instructional materials and interactive tutorials.

Table 3 Statistical descriptive results

Data Decryption	Variable X	Variable Y
Variable Data	Highest score: 236 Lowest score: 167	Highest score: 93 Lowest score: 78
Average Variable Answer	Average answer score: 4/5 or agree/strongly agree	Average score : 85.34
Results of Variable Analysis	Score 167-176 : 3 177-186 : 8 187-196 : 11 197-206 : 12 207-216 : 23 217-226 : 12 227-236 : 2	Score 78-79 : 8 80-82 : 12 83-84 : 8 85-86 : 13 87-88 : 13 89-90 : 9 91-93 : 8
Mean, Median, Mode, Standard Deviation	Mean: 203.63 Median: 205 Mode: 208 Standard Deviation: 15,203	Mean: 85.34 Median: 86 Mode: 80 Standard Deviation: 4,147
Level	There were 3 students in the very poor category (4%), 8 students (11%) in the poor category, 11 students (15%) in the poor category, 12 students in the adequate category (17%), 23 students (32%) in the good category, 12 students (17%) in the very good category and 2 students (3%) in the very good category. Based on the results of obtaining these scores, it can be concluded that the use of telegram bots as a learning resource in graphic design subjects is in the good category, namely with a percentage (32%)	There are 8 students (11%) in the very poor category, 12 students (17%) in the poor category, 8 students (11%) in the poor category, 13 students (18%) in the good category (18%), 9 students (13%) in the good category and 8 students (11%) in the very good category. Based on the results of obtaining these scores, it can be concluded that the learning outcomes in graphic design subjects are in the good category,

B. Results of the analysis prerequisite test

The data analysis prerequisite test is essential before performing statistical analysis to verify that the data meets the necessary assumptions and conditions, ensuring that the results derived from the analysis are reliable and valid. This stage is crucial because the statistical methods may yield misleading or inaccurate conclusions if the data does not meet specific criteria.

In this study, two specific prerequisite tests were conducted: normality tests and linearity tests. The normality test assessed whether the data follows a normal distribution, a key assumption for many statistical techniques. On the other hand, the linearity test was employed to determine whether the relationship between the variables is linear, as many statistical models assume a linear relationship between the variables. The results of these prerequisite tests are crucial in guiding the selection of appropriate analytical methods and ensuring the robustness of the findings in this study.

Table 4 Results of the analysis prerequisite test

Normality Test	The Exact Sig. (2-tailed) The residual value of the X variable (Telegram Bot Use) in this study is normally distributed because it is 0.216 > 0.05. The Y variable (Learning Outcome) in this study is also normally distributed because it is 0.495 > 0.05
Linearity Test	The significance value of the Deviation from Linearity is 0.060, so the assumption of linearity is fulfilled because the Deviation from Linearity is 0.060 > 0.05

The results of this study's normality and linearity tests indicate that the data meets the necessary assumptions for valid statistical analysis. For the normality test, the residual value of the X variable (Telegram Bot Use) was found to be 0.216, which is greater than the 0.05 threshold, confirming that the distribution of this variable is normal. Similarly, the Y variable (Learning Outcome) also showed a normal distribution, with a significant value of 0.495, well above the 0.05 cutoff. Regarding the linearity test, the significance value for the Deviation from Linearity was 0.060, which is greater than 0.05, indicating that the assumption of linearity is fulfilled. These findings suggest that the data is suitable for further statistical analysis, as both normality and linearity assumptions have been met.

C. Hypothesis test results

Hypothesis testing is a critical step in data analysis that allows researchers to make informed decisions and draw conclusions based on the data. It involves testing an initial assumption or hypothesis by comparing it against the data to determine its validity. In this study, hypothesis testing was conducted using two key statistical methods: the correlation test and the determinant coefficient test.

The correlation test was used to assess the strength and direction of the relationship between variables, helping to determine whether they have a statistically significant association. On the other hand, the determinant coefficient test was used to evaluate how well the independent variable(s) can explain the variance in the dependent variable, providing insight into the proportion of variation accounted for by the model. The results of these tests are essential for understanding the relationships between the studied variables and for confirming or refuting the hypotheses posed in the research.

Table 5 Results of hypothesis test

Correlation Test	The Pearson correlation value of variable X (Use of Telegram Bot) and variable Y (student learning outcomes) was 0.821 > 0.05
Coefficient of Determination Test	The determination coefficient (R Square) value was 0.674 (67.4%).

Based on the results of the calculation of data obtained from the field, it was concluded that using telegram bots as a learning resource in Graphic Design was strongly and significantly related to the learning outcomes of grade XI PPLG students. The results of this study prove that the existence of a significance value of 0.000 ($p < 0.01$) confirms the significance of the relationship in the study between the use of the Telegram bot and student learning outcomes.

From the data analysis, a positive correlation was found between variable X (Use of Telegram Bot) and variable Y (Learning Outcomes), with a Pearson correlation value of 0.821, which is greater than 0.05. This indicates a significant relationship between the use of Telegram bots and learning outcomes at a high level. Based on these positive correlation findings, it can be concluded that students' increased use of Telegram bots is proportional to their improved lear-

ning outcomes. Conversely, lower use of Telegram bots is associated with lower learning outcomes. These results support the hypothesis that there is a significant positive relationship between using Telegram bots and favourable learning outcomes. In other words, the more students use Telegram bots, the better their learning outcomes; the less they use them, the lower their learning outcomes.

Based on the determination results, the coefficient value of determination (R Square) of 0.674 shows that telegram bots contribute 67.4% to learning outcomes, while other factors influence the remaining 32.6%. Nonetheless, Sabri (2010) must raise these other factors: internal factors from within students and external factors from outside students. This is in line with the research of Lapasere *et al.* (2022) which discusses factors that can affect student learning outcomes, namely internal and external factors, where one of the internal factors is a separate way of learning when students are at home.

The results of this study indicate that using Telegram bots as a learning resource can be one of the effective strategies for improving student learning outcomes. Oktavia & Sriyono (2022) proved that Telegram bots in learning are effectively used to improve student learning outcomes. Telegram bots also encourage the development of more interactive learning methods based on technology. As evidenced in Putra & Dermawan (2021) Telegram bots can also incorporate technological elements such as gamification or animation that make learning more engaging and interactive.

Based on the study results, it is evident that integrating Telegram bots into learning activities can significantly enhance the learning experience and improve education quality. One of the key benefits of using Telegram bots is their ability to be combined with other educational apps, platforms, and social media to create a more interconnected and dynamic learning ecosystem. For instance, by integrating Telegram bots with existing learning management systems (LMS), schools and educators can develop a more cohesive and comprehensive digital environment. This integration allows for seamless communication, real-time updates, and easy access to learning resources, enabling more interactive and engaging lessons.

Additionally, incorporating other apps and platforms, such as Google Classroom, Zoom, or social media platforms like WhatsApp and Telegram bots can further support collaborative learning and provide students with various tools to enhance their academic experience. Telegram bots can also be optimised for distance learning, offering a valuable resource for students participating in on-the-job training programs, during school closures, or in emergencies. These bots can deliver personalised feedback, answer questions, and provide learning materials in real time, ensuring that students remain engaged and on track with their studies. Overall, integrating Telegram bots with other educational technologies promises to bring long-term benefits, fostering a more inclusive, flexible, and efficient learning environment that will ultimately improve student achievement and contribute to the overall quality of education.

CONCLUSION

In conclusion, the research demonstrates that the use of Telegram bots as a learning resource in graphic design subjects has a significant positive impact on student engagement, access to learning materials, and overall learning flexibility. The implementation of Telegram bots has successfully created a dynamic and interactive learning environment that aligns with the digital era's educational needs. Additionally, the study found a notable improvement in learning outcomes, with the average final assessment score increasing from 82 in the previous school year to 85.34 in 2023/2024 after incorporating Telegram bots. While this 3-point increase may seem modest, it holds meaningful value in the educational context. The research also confirmed a very strong correlation between the use of Telegram bots and learning outcomes, with a product moment correlation significance value of 0.000 and an R value of 0.821, indicating a positive relationship between Telegram bot usage and improved student achievement in graphic design. This

highlights the effectiveness of Telegram bots in enhancing educational outcomes, although other factors may also contribute to the results.

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