Volume 3, Issue 2: July 2024, pp.01-14 DOI: https://doi.org/10.56921/jumper.v3i2.198

JUMPER: JOURNAL OF EDUCATIONAL MULTIDISCIPLINARY RESEARCH
e-ISSN 2964-0024 | p-ISSN 2963-5357
http://jurnal.catimoredansahabat.my.id/index.php/jumper

Enhancing Students' Performance in Integrated Project Course through Collaborative Learning and Open Artificial Intelligence Chatbot

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Info Artikel

Diajukan: *18-03-2024*
Diterima: *01-06-2024*
Diterbitkan: *31-07-2024*

Keywords:
Collaborative Learning; Artificial Intelligence Chatbot.; Action Research; Final Year Project;

Kata Kunci:
Pembelajaran Kolaboratif; Chatbot Kecerdasan Buatan.; Kajian Tindakan; Projek Tahun Akhir;

Abstract

Numerous students faced challenges related to specific concepts, deeming it essential to seek supplementary guidance for the successful completion of their mandatory final semester projects within the Integrated Project Course. This need arose early in the project development phase, and these individuals consistently encountered difficulties in bringing their projects to fruition. The challenges stemmed from the intricate nature of the course material and the inadequacy of suitable guidance. As a result, some students occasionally delivered incomplete and below-par project outcomes. Consequently, this research endeavors to enhance students' final semester project performance by employing collaborative learning methods and integrating an Open Artificial Intelligence Chatbot as interventions. The study was conducted during the session II 2022/2023 in the Department of Information and Communication Technology at Polytechnic Sultan Abdul Halim Mu'adzam Shah, involving 12 students enrolled in the Integrated Project Course and receive score mark below five during their Demonstration One presentation session. Data collection included rubric scores and reflective journals, which were analyzed based on rubric percentages before and after the intervention. The findings of the study indicated an improvement in rubric scores before and after the intervention, signifying an enhancement in students' project-related performance. Additionally, the reflective journal provided insights into the students' learning experiences with both interventions. This research contributes to educators' comprehension of effective methods for elevating students' performance in Integrated Project Course by leveraging contemporary technologies and approaches. Future research initiatives could further diversify teaching and learning methods in Integrated Project through the organization of workshops specifically addressing current technology and knowledge pertinent to the development of final semester projects.

Abstrak

Ramai pelajar menghadapi cabaran yang berkaitan dengan konsep tertentu, menganggap penting untuk mendapatkan bimbingan tambahan untuk berjaya menyelesaikan projek semester akhir wajib mereka dalam Kursus *Integrated Project*. Keperluan ini timbul pada awal fasa pembangunan projek, dan individu ini secara konsisten menghadapi kesukaran dalam melaksanakan projek mereka. Cabaran tersebut berpunca daripada sifat rumit bahan kursus dan ketidakcukupan bimbingan yang sesuai. Akibatnya, sesetengah pelajar kadangkala menyampaikan hasil projek yang tidak lengkap dan mendapat markah yang rendah. Oleh itu, penyelidikan ini berusaha untuk meningkatkan prestasi projek semester akhir pelajar dengan menggunakan kaedah pembelajaran kolaboratif dan mengintegrasikan Chatbot Kepintaran Buatan sebagai intervensi. Kajian dijalankan pada sesi II 2022/2023 di Jabatan Teknologi Maklumat dan Komunikasi Politeknik Sultan Abdul Halim Mu'adzam Shah, melibatkan 12 pelajar yang mengikuti Kursus *Integrated Project* dan mendapat markah di bawah lima semasa sesi pembentangan Demonstrasi Satu. Pengumpulan data termasuk skor rubrik dan jurnal reflektif, yang dianalisis berdasarkan peratusan rubrik sebelum dan selepas intervensi. Dapatan kajian menunjukkan peningkatan dalam markah rubrik sebelum dan selepas intervensi, menandakan peningkatan dalam prestasi berkaitan projek pelajar. Selain itu, jurnal reflektif memberikan pandangan tentang pengalaman pembelajaran pelajar dengan kedua-dua intervensi. Penyelidikan ini menyumbang kepada kefahaman pendidik tentang kaedah berkesan untuk meningkatkan prestasi pelajar dalam Kursus *Integrated Project* dengan memanfaatkan teknologi dan pendekatan kontemporari. Inisiatif penyelidikan masa depan boleh mempelbagaikan lagi kaedah pengajaran dan pembelajaran dalam kursus *Integrated Project* melalui penganjuran bengkel khusus berkaitan teknologi dan pengetahuan semasa yang berkaitan dengan pembangunan projek semester akhir.

Introduction

The Integrated Project Course provides students with practical and design experience in independently carrying out software applications and technical projects. Students are expected to complete the entire project lifecycle, including requirements gathering, implementation, testing, and delivery, as well as presenting their final projects. In addition to acquiring new technical knowledge and skills, this course also aims to foster the development of students' generic skills, such as teamwork, project management, communication, problem-solving, and technical writing. Through this approach, this course aims to encourage independent and lifelong learning among students. Therefore, the Integrated Project Course is a crucial subject for students who studies in Diploma

Information Technology (Technology Digital) (DDT) at Polytechnic Sultan Abdul Halim Mu'adzam Shah (POLIMAS). This course is a compulsory course to be taken by the fifth semester diploma student which requires students to develop a project that integrates the skills and knowledge they have learned throughout their studies (Sulaiman & Bakeri, 2022). According to Barko and Sadler (2016), students need practical hands-on experience to gain a comprehensive understanding of the subject matter and to effectively apply their theoretical knowledge in real-world scenarios. Thus, the objectives of this course is to provide students with an opportunity to apply their theoretical knowledge to real-world projects and enhance their practical skills.

As the course requires both theoretical and practical understanding, lecturers should use variety of teaching and learning methods to assist students in developing their projects. Employing appropriate teaching and learning techniques can enhance students' involvement and drive, resulting in better scholastic achievements (Munir et al., 2019). In addition to lectures, there are numerous teachings and learning approaches that can aid students in comprehending the subject matter. Studies have demonstrated that the utilization of multiple and relevant teaching approaches by educators can result in heightened student involvement, drive, and knowledge retention, which in turn can lead to improved academic accomplishments (Dunn et al., 2013). Hence, this action research aimed to employ teaching and learning methods as an intervention to determine an effective approach in enhancing students performance in Integrated Project Course.

Background of Study

It was compulsory for students in semester five to register and pass for Integrated Project Course before going for industrial training. The Integrated Project Course was considered one of the toughest courses in Diploma Information Technology (Technology Digital) program since it contributes four credit hours and need to produce one complete software which need to achieve at least three main objectives of their software's project within fourteen week study. However, some students struggled with certain concepts or required additional guidance and support to develop their own software from the beginning. They often faced difficulties in completing their projects due to the complexity of the course and the lack of proper guidance, which sometimes resulted in the development of incomplete and inadequate projects. Thus, early action needs to be taken at the beginning of the semester to help these students.

Based on researcher's experience, while observing the Integrated Project class, the students could be classified into three groups based on their performance levels: fast, intermediate, and slow. Researchers noticed that the group with slower performance often required additional guidance and attention from both the lecturer and supervisor to ensure that they could develop their projects successfully and meet the project objectives.

Additionally, they struggle with locating and accessing resources and materials that are relevant to their project. As the project is tailored to their client's specific problem, there may not be an exact system or website that matches their needs entirely available on the internet as references. Therefore, they must learn how to adapt their references and incorporate programming code that is relevant to their project.

To address these problems, this study aimed to enhance students' final semester project performance by employing collaborative learning methods and integrating an Open Artificial Intelligence Chatbot as interventions. The study was conducted during the session II 2022/2023 for student who enrolled Integrated Project Course offering by Information Technology and Communication Department at POLIMAS. There are 12 students divided into 4 groups and receive total score mark below five during their Demonstration 1 presentation session is participant for this study. The data collected from this study can help educators and students understand the appropriate methods to enhance students' skills and knowledge in Integrated Project by utilizing current technologies and methods.

Literature Review

Integrated Project Course is a course that DDT students must study and pass before they get their diploma. This course is one of the difficult courses where students have to complete a project developed within 14 weeks by meeting the criteria that have been set. This course sets 5 hours of meetings a week where students have to attend a theory class for 2 hours and attend a meeting with the supervisor for 3 hours. In this course students need to complete a project that meets the basic fields of information technology such as software application, web application, mobile application, Internet of things (IOT) and others which are related to student program track (Sulaiman & Bakeri, 2022). At POLIMAS, software and application development track is the only one track that offers for DDT student session II 2022/2023. Students will be evaluated four times starting with presenting project proposal, Demonstration 1, Demonstration 2, and Demonstration 3. During Demonstration 1 student must achieved forty percent progress of project development and eighty percent project content which offer solution to the problem that written in proposal. At this phase, student should design their main structure of project, such as login page, homepage, data can transfer between database and interface and other main functionality of the project must be working.

The methodology of teaching is considered one of the most important pillars in the educational process (Mustapha 2022). Besides that, interesting teaching and learning methods are important in helping improve student achievement in a course. This is because students need to understand the course they are studying so that they can perform the tasks given successfully. There are various teaching and learning methods

that can be applied during teaching and learning sessions such as group discussion, watching learning videos, question-answer, peer learning, collaborative learning and others. Chen et al. (2021) defined collaborative learning as a teaching method that involves students working together in small groups to achieve a shared learning objective. It requires students to collaborate, share knowledge and resources, and take responsibility for their own learning as well as their peers' learning outcomes. Collaborative learning related to instructional arrangements that two or more students working together on a shared learning goal (Asterhan & Schwarz, 2016). Students are encouraged to ask questions, give elaborate explanations, exchange arguments, formulate new ideas and problem solutions. (Leeuwen & Janssen, 2019).

AI chatbot are computer programs that use natural language processing and machine learning algorithms to simulate human conversation. AI chatbot have been used in various fields, including education, to provide instant feedback, support, and guidance to students. Bulla et al. (2020) described an AI chatbot as an agent that engages in automated conversations with users by employing techniques such as natural language processing and machine learning. The chatbot can effectively comprehend user queries, deliver tailored responses, and enhance its performance by learning from user interactions, thereby simulating human-like conversations. The implementation of AI chatbot using the AI language model created by OpenAI, known as ChatGPT. An important aspect emphasized to students regarding ChatGPT was critical evaluation. Students were expected to critically evaluate the responses generated by ChatGPT, assessing their accuracy, reliability, and relevance. When necessary, they were encouraged to verify the information provided against credible sources. Collaboration and discussion among students regarding their prompts and the generated responses were also encouraged. This created a supportive learning environment where students could learn from each other, exchange ideas, and evaluate the effectiveness of different prompts. Essentially, ChatGPT served as a tool to assist students in developing their projects by generating text-based content, answering questions, providing explanations, and engaging in informative conversations. By understanding the functions of ChatGPT, students were able to effectively leverage ChatGPT and optimize their interactions to enhance their learning experiences.

Methodology

Action Research Model

In the context of action research, the methodology encompasses the overarching approach and specific procedures employed to carry out the research study. It encompasses the systematic framework that outlines the necessary steps and techniques used to explore and resolve the identified problem or issue, as well as collect, analyse, and interpret data to generate meaningful findings. Therefore, this paper adopted the action research cycle model by Stringer (2007) as illustrated in Figure 1. Basically, there are three phases in this cycle namely look, think and act. During the first look phase, researchers engage in active observation and data collection to gain a comprehensive understanding of the problem or issue under investigation. Next phase which is think dedicate the researcher's attention to analysing and reflecting upon the data collected in the previous look phase. Lastly, the act phase moves from analysis and reflection to taking concrete action based on their findings. This phase involves devising and implementing interventions or strategies aimed at addressing the identified problem.

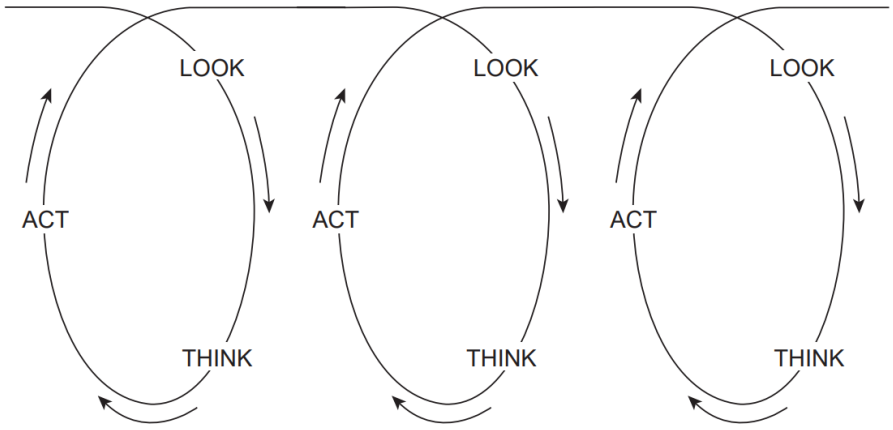

Figure 1: Action Research Cycle Model Adapted from Stringer (2007).

Look Phase (Problem Review)

The primary objective in this phase remains consistent as to explore and collect pertinent information in order to identify and clearly define the problem at hand. In this paper, researchers begin by clearly defining the problem or issue they intend to investigate. There are 45 students grouped into 3 persons per group presented their project proposal during week three and start develop their project during week four and week five. The issue that needed to be addressed was based on the initial observation of

the researchers, who found that there was some group of students who were relatively weak in developing their final semester projects. These students required additional assistance and attention from both their lecturer and supervisor to ensure that they successfully completed their final semester projects within the designated time frame.

Think Phase (Analysis of Problem review)

In this phase, these weak students were identified through the rubric marks of Demonstration 1, which was one of the continuous assessments in the Integrated Project Course. During the Demonstration 1 phase, all 15 groups was tasked with delivering a presentation showcasing their developed project. The evaluation criteria employed in this phase encompassed aspects such as the progress of project development, interface structure, conceptualization of the project, system security, and testing. Four groups, consisting of 12 students, were selected to participate in this action research project because their rubric marks indicated that this group received scores below 5 marks.

Typically, students who obtained scores below 5 marks demonstrated a limited ability to execute the fundamental elements of the project, including the implementation of essential features such as the login function, database connectivity, and form creation and submission. Proficiency in these foundational aspects holds utmost significance as it serves as a prerequisite for progressing to subsequent stages of website or system development. Thus, the researcher was concerned that if no action was taken, these groups would continue to receive low marks and consequently be unable to develop their final semester project according to the required standards. Therefore, these four groups of weak students needed to be supported from the beginning of the semester to ensure rapid progress in their development.

Act Phase (Implemented Action)

In this phase, researchers take action based on the analysis and reflection conducted during the previous phases of look and think. The primary goal of the act phase is to implement interventions or strategies aimed at addressing the identified problem or issue. There were two types of interventions that were used by the researcher to assist weak students in developing their final projects, namely collaborative learning and the use of an open AI chatbot. Further explanation about both interventions is provided in the next subtopic.

Intervention

Collaborative Learning

The first intervention used in this action research was collaborative learning. The implementation of collaborative learning took place in week seven, following the

identification of weak students based on the marks assigned during Demonstration 1. Prior to week six, students engaged in discussions with their supervisor regarding the project title and scope. Subsequently, they proceeded to document their project proposal. Once the proposal was submitted and approved, students began developing their projects. Therefore, the progress and achievements of the students in project development were observed from week four to week six. During this period, they utilized their knowledge and skills to advance their projects. The assessment of Demonstration 1 will be conducted in week six according to the project planner as shown in table 1.

In week 7, the researchers requested the three groups with the highest marks in Demonstration 1 to present the progress of their projects in front of the four selected groups participating in this action research. Through this process, the four groups were able to learn, ask questions, and exchange opinions with the fast learner group. As communication and discussions took place among them, a rapport and trust were indirectly established. Consequently, in the future, these four groups would not hesitate or feel shy to seek clarification or ask questions to the fast learner group. The collaborative learning between both groups continued intermittently until the end of the semester.

Table 1: Gantt Chart of Project Planner for Integrated Project

WEEKS / PLANNING	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
1.0 PROJECT PROPOSAL 1.1 Prepare project plan and project design														
Proposal Presentation														
2.0 PROJECT DEVELOPMENT 2.1 Plan requirement and design specification														
Demo 1 Presentation														
2.2 Manage the hardware or software configuration. 2.3 Develop problem specification and design														
Demo 2 Presentation														
3.0 DELIVERABLES 3.1 Present deliverables														
Demo 3 Presentation														
3.2 Prepare project documentation. 3.3 Present Final Project														
1. Log Book **2. Technical Report**														

Open Artificial Intelligence (AI) Chatbot

Next intervention used in this action research was Open Artificial Intelligence (AI) also occurred in week seven, parallel to the collaborative learning intervention. As ChatGPT emerged as a novel introduction to users, the students were not exempted from lacking familiarity with the utilization of chatGPT. Consequently, a dedicated session

comprising an introduction and training on chatGPT was conducted within the classroom setting for the participating students. The primary objective of this session was to provide an initial exposure to ChatGPT and to impart effective strategies for interacting with the tool, thereby maximizing its potential in supporting the students' learning endeavors. During the session, students were instructed on the importance of formulating clear and specific prompts to ensure the retrieval of accurate and relevant information from ChatGPT. Moreover, students were encouraged to engage in experimentation with different prompts and iterate their queries in order to explore diverse perspectives and gain deeper insights. The iterative refinement of prompts facilitated improved outcomes and enhanced comprehension of the capabilities of ChatGPT. As part of the learning process, students were provided with exercises in class, allowing them to practice using different prompts until they obtained satisfactory answers. This approach aimed to foster critical thinking and refine students' ability to effectively engage with ChatGPT.

Reflective Journal

After finish intervention session, student should answer reflective journal which prepared by researcher in Google Form. The reflective journal consists of three questions and student need to write their feedback about technique that used during intervention session. The 12 students who participate the intervention session present their post Demonstration 1 on week eight.

Results and Discussion

This section presents the key findings derived from the analysis of data collected during the action research process. The findings shed light on the impact and effectiveness of the interventions implemented to address the identified problem. The data analysis involved both qualitative and quantitative methods to provide a comprehensive understanding of the research outcomes. The quantitative data was analysed from the pre and post Demonstration 1 rubric scores. Meanwhile, the qualitative data was analysed from the students' reflective journals. Both quantitative and qualitative findings highlighted the data in the form of numeric and also provide depth understanding about student learning experiences using both interventions.

In this action research, the pre and post demonstration 1 rubric was used to assess the students' performance and progress in their project development. Based on Table 2, the pre demonstration 1 results indicated that a total of 12 students, comprising four project groups, obtained low rubric scores below 5, which were considered unsatisfactory. However, after the implementation of the two interventions, the post demonstration 1 scores showed an improvement compared to the pre demonstration scores. The findings regarding the results of the pre and post demonstration 1 rubric revealed significant

increment in the students' results as shown in Figure 1 in which three groups obtained marks above 5 where contributed to increment percentage of 50 %, 83 % and 133 %. However, there was one group that still obtained marks below 5, even though this group experienced increment percentage of 75%.

In addition, when comparing the pre demonstration scores to the post demonstration scores, a notable increase in the mean scores was observed as shown in table 3. This indicates that the interventions implemented during the action research process had a positive impact on students' project development. The average score in the pre-demonstration was 3, while the average score in the post-demonstration significantly increased to 5.5. Furthermore, despite initial score differences, all students demonstrated improvement after the teaching method, with an average 20% score jump**.** Notably, some students achieved remarkable 133% gains, while the highest initial scorers showed the widest range of progress. This statistically significant improvement confirms the demonstration's positive impact on learning as shown in figure 2, inviting further investigation into specific factors influencing individual performance.

It can be seen that from the findings, there were two categories of groups. Three groups were able to obtain satisfactory marks while the other one group still obtained unsatisfactory even after the intervention was implemented. From the observation in class and marks scored by the unsatisfactory group, they were identified as weak students that needed more types of interventions rather than collaborative and AI chatbot. In addition, they need to give more attention towards skills and knowledge in programming. However, other three groups can improve their marks over 5 and can work by themselves independently in developing their final semester project. In conclusion, the presented data serves as a compelling testament to the effectiveness of the implemented demonstration in fostering significant learning gains for students of all skill levels. Future research, delving deeper into the observed individual variances and their underlying causes, has the potential to further refine the method and maximize its impact on student learning across diverse classrooms.

Table 2
Results of Pre and Post Demonstration 1.

No.	Name	Pre Demonstration score	Post Demonstration score	Increment Percentage
1	Student 1	4.0/10	6.0/10	50%
2	Student 2	4.0/10	6.0/10	50%
3	Student 3	4.0/10	6.0/10	50%

4	Student 4	3.0/10	5.5/10	83%
5	Student 5	3.0/10	5.5/10	83%
6	Student 6	3.0/10	5.5/10	83%
7	Student 7	3.0/10	7.0/10	133%
8	Student 8	3.0/10	7.0/10	133%
9	Student 9	3.0/10	7.0/10	133%
10	Student 10	2.0/10	3.5/10	75%
11	Student 11	2.0/10	3.5/10	75%
12	Student 12	2.0/10	3.5/10	75%

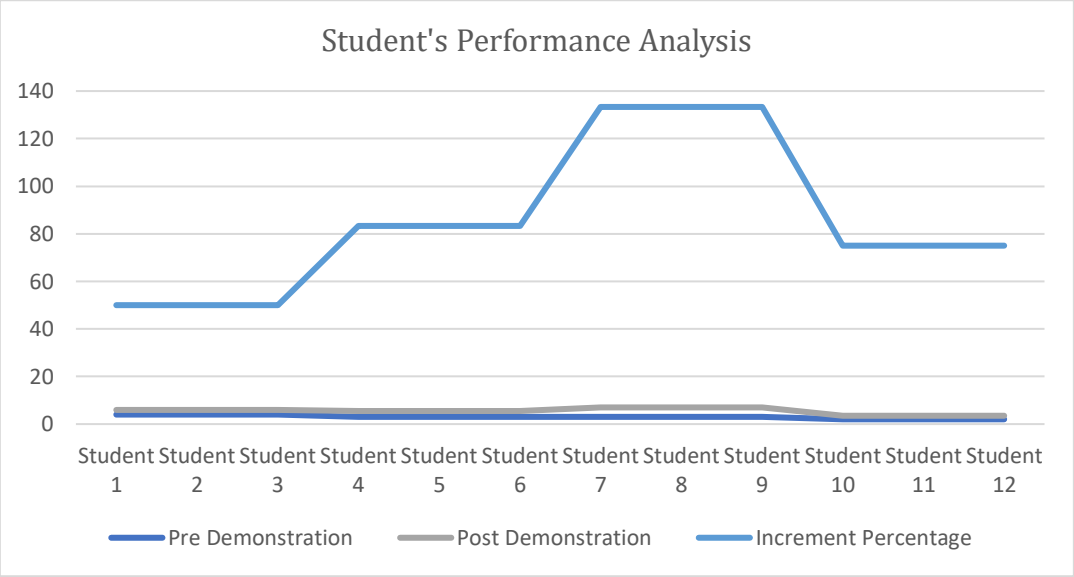

Figure 1: Student's Performance Analysis

Table 3: Descriptive Statistic

Statistic	Pre-Demonstration Score	Post-Demonstration Score	Percentage Increase
Mean	4.83	5.83	20.48%
Standard Deviation	1.76	1.81	40.84%
Minimum	2	3	50.00%
Maximum	7	7	133.33%

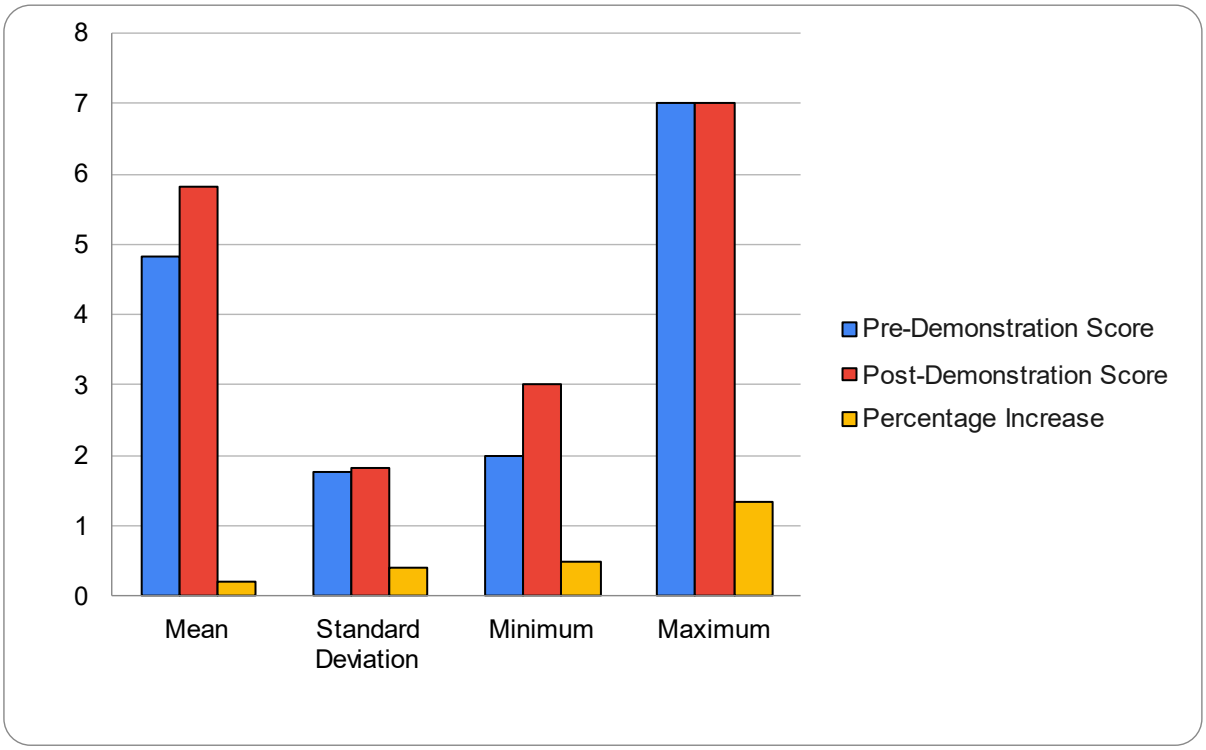

Figure 2: Descriptive Statistic of Student Performance Analysis

Next, this action research also collected feedback from these students through reflective journals. Here, their learning experiences after the interventions were used could be understood. The students filled out a Google form for the reflective journal, and it was observed that the first intervention, which involved collaborative learning, really helped the students in developing their final semester project. Feedback from Student number 2 mentioned that students from different groups provided ideas that were included in the final semester project, and this idea greatly enhanced their project. Another student number10 added that through the presentations of other groups, their group was able to incorporate information or features that were lacking in their project.

In addition, the second intervention was an Open AI Chatbot that also assisted students in their final semester project, specifically related to fixing coding errors and providing concise explanations regarding any queries. According to student number 5, the AI Chatbot truly assisted them in improving their coding and identifying errors. Student number 7 mentioned that the Open AI Chatbot was helpful in correcting errors and alleviating confusion that arose during the process of creating the final year project. Furthermore, student number 8 expressed satisfaction with the Open AI Chatbot's ability to explain coding and information concisely in an easily understandable manner.

In addition, the involved students provided opinions for further enhancement regarding collaborative learning and the Open AI chatbot. For example, student number 4 suggested that groups working on projects in the same category be placed in one group, such as a Telegram group, to facilitate sharing and discussion related to the development of the final semester project. Another student which was student number 1 recommended that students should be exposed to concise techniques and queries while interacting with the Open AI chatbot. This exposure would enable them to obtain correct and relevant answers and gain a better understanding of techniques needed to receive comprehensive and accurate responses.

In future action research, researchers might consider diversifying teaching and learning methods, just like the interventions in the Integrated Project. For instance, they could organize workshops that concentrate on the latest technology, skills, and knowledge essential for Information Technology (IT) students in the context of developing final semester projects. Given the rapid growth of the IT field, it becomes crucial for students to familiarize themselves with and grasp current technology to meet the demands of their final semester projects and enhance their employability prospects reflected in their job resumes.

Conclusion

In conclusion, this study investigated the progress or performance of students when using two types of intervention in order to improve their performance in final semester project development. Through data analysis of pre and post demonstration 1 rubric, the findings highlight significant increments of marks over 5 obtained by 3 groups of students. However, one group still obtained unsatisfactory marks which was below 5 marks needed more or different intervention to support them in developing the final semester project. Besides that, this action research also provided students invaluable perspectives on their learning experiences using both collaborative and open AI chatbot through data analysis of reflective journals.

From the findings, researchers discovered that the two interventions could be applied to moderate student levels, providing significant assistance. However, for the slow level students, they needed more interventions or different approaches to aid them in developing the final semester project. For future action research, researchers could diversify teaching and learning methods as the interventions in Integrated Project. For example, by organizing workshops specifically focused on the current technology, skills, and knowledge required for Information Technology (IT) students in relation to the development of final semester projects. As the IT field grew rapidly, it was important for the students to be familiar with and learn about the current technology to adapt to the demands of the final semester project, thereby adding value to their job resume.

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