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INTEGRATING CHATBOT IN AN INQUIRY-BASED APPROACH IN TEACHING SCIENCE

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ABSTRACT

Science can be a challenging subject for both teachers and students. As technology in education is constantly evolving, this study aimed to explore the integration of Chatbot in an Inquiry-based approach in teaching science. This exploration measured the effect of Chatbot on the students' academic achievement and science engagement. The research participants consisted of thirty (30) grade 8 students from Pagadian City Science High School for the school year 2022-2023. This exploration utilized pre-experimental research design in order to determine the improvement of the students' academic achievement integrating Chatbot in an Inquiry-based approach in teaching Science. This study focused on the One Group Pre-test-Post-test design where only the experimental group is selected as the study subjects. In this study there was no control group as this design advised. By employing Mean and Paired Samples T-test, results revealed there is a very high significant difference between the level of students' engagement and achievement before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science in the first, second, and third trial runs. Therefore, integrating Chatbot in an Inquiry-based approach in teaching Science is highly recommended to maximize the learning of the students. Findings of the study also provided for the better implementation of the current science curriculum, which is geared towards producing active learners through technology integration.

KEYWORDS: *chatbot technology; chatbot in science education; inquiry-based approach; student's science engagement; academic achievement*

CONTEXT AND RATIONALE

Technology integration in education has created new possibilities in order for students to obtain knowledge and work with others, and engage in more interactive and personalized learning experiences. The extensive usage of the internet and mobile devices has made access to online resources for students simpler and connect with their peers, teachers, and experts worldwide. Additionally, the development of new educational technologies such as virtual and augmented reality, learning management systems, and artificial intelligence is leading to new pedagogical approaches and innovative teaching and assessment methods. These developments are helping to create a more dynamic and a stimulating setting for learning and student success. Technological innovations are influencing every aspect of life, and continuous technological advances are changing how a learner learns (Sürmelioğlu and Seferoğlu 2019, 48).

Science can be a challenging subject for both teachers and students. Science is not just about memorizing facts and formulas, but also understanding complex concepts and scientific principles and enhancing one's capacity for critical thought and problem solving. This context can make it difficult for some students to grasp the material and for some teachers to convey it effectively. Additionally, Science is constantly evolving, so teachers need to feature the most recent advancements and discoveries in the field. However, when taught effectively, Science can be a fascinating and engaging subject that can inspire to encourage youngsters to major in science and technology (Hadzigeorgiou and Schulz 2019, 2). A crucial pedagogical strategy used by educators in a variety of subjects, including science, is inquiry-based learning (Del Greco, Bernadowski, and Parker 2018, 75).

One of the popular modern teaching methods used in science education is Inquiry-Based Learning (IBL), which has been demonstrated to be a highly effective way to learn science. IBL is based on the principles of social constructivism, which recognize the student's potential in the classroom (Ünlü and Dökme 2020, 120). Recently, the 5Es approach has been expanded to include two additional phases, Elicit and Extend, resulting in a 7Es instructional model (Eisenkraft 2003, 56). Moreover, studies have shown that incorporating technology into inquiry-based learning can have a positive impact on students' academic performance and attitudes towards learning (Thongkoo, Panjaburee, and Daungcharone 2017, 527).

A Chatbot, sometimes known as a "talking bot," is an emerging type of software in the field of information technology (Shorey et al. 2019), able to engage in vocal or written dialogues with human users and respond to their questions utilizing the question-and-answer method (Lee and Park 2019, 79). Since technology in education today is changing how students learn, many potential methods with technical support can be integrated as a digital

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learning tool to help students' study information through individualized learning support (Singh 2021). Additionally, some research has combined collaborative learning with mobile learning (Aghajani and Adloo 2018, 433).

The primary action of a chatbot begins with the user's input. The message was then analyzed by NLP (Natural Language Processing), and the chatbot responded by replying to the message based on the database. For example, if a user sends a "how are you?" message, the chatbot will look through the database for answers that match this question, such as "I'm doing OK", "Great!" etc. The ability of a chatbot to meet the needs of users has long been an issue in the field of information retrieval (Zhao et al. 2016, 5). Chatbots may be divided into two types based on how they are designed: those that are programmed according to predefined commands (rule-based Chatbot) (Singh, Joesph, and Jabbar 2019, 2) and those that are based on artificial intelligence (AI) (Zamora 2017, 2). Facebook launched its Messenger platform in April 2016 with the goal of enabling chatbots to be integrated into the application. Since then, the platform has amassed over 1.3 billion monthly users (Constine 2018, 5), accounts with more than 300,000 chatbots, and 8 billion messages are sent and received daily between companies and customers (Johnson 2018).

There is little barrier to entry when it comes to using a Facebook Messenger chatbot. Facebook Messenger is the third most popular smartphone application globally, with 68 percent of users (Hartmans 2017, 8). Users benefit from a familiar user interface, not necessary to download and set up additional applications, and 24/7 availability. A drawback of the instant messaging software is that other discussions can disrupt your conversation (Pereira and Díaz 2018).

The utilization of the social platform's already-existing infrastructure, the personalization of the discussion, and the chatbot's availability on mobile and the web are just a few advantages for chatbot creators. Any programming language or a third-party no-code platform using a visual development environment can be used to create chatbots (Smutný and Schreiberova 2020, 103).

As technology in education is constantly evolving, the Chatbot may significantly impact the sector. This work may serve as a stepping stone for researchers attempting to realize this prospect. This task would be accomplished by determining what skills the Chatbot would have in an educational context and whether it could stand alone or require other technology to bring pedagogical value to education (Roos 2018, 46).

These technologies that aid in the teaching-learning process are a significant advantage in making the lessons more manageable and will also improve students' performance in science. As a response to the things mentioned above, the researcher is challenged to develop an instruction that includes the use of Chatbots in helping the students gain more knowledge and, in effect, increase their academic achievement and student engagement in science. In addition, the researcher will observe the positive influence of using such technology in increasing the students' class participation and will provide a better performance outcome.

Because of the potential and possibility of Chatbot technology to meet the real-time information needs of the students and as a digital learning tool to integrate in an Inquiry-based approach for use in education, as well as the limited availability of research on Chatbot technology in educational contexts, particularly in the Philippines, the current study aimed to improve Filipino students' Science concepts by integrating Chatbot in an Inquiry-based approach in teaching Science. Through this digital platform, the goal of using a chatbot in the classroom is to increase students' interest in science, their academic achievement, and to provide them with positive, individualized learning support.

INNOVATION, INTERVENTION, AND STRATEGY

In order to achieve greater lengths in knowledge acquisition, the researcher believed that learners should be involved in the teaching-learning process. As a result, teachers must redesign their lessons in order to create instructions that are tailored to the needs of their students, as well as place a greater emphasis on engaging them and allowing them to participate in inquiry-based activities.

In this research study, the researcher opted to create a Chatbot based on retrieval information since it allows the researcher to utilize the results gain from Facebook Messenger and Manychat. The developed Chatbot integrated in the lesson plans followed the 7Es Inquiry-based approach with learning objectives at the beginning of the instruction. The lesson plans developed were based from the least learned competencies and lessons were aligned to the Most Essential Learning Competencies.

A chatbot is a computer program that mimics normal speech styles in order to engage in conversational engagements with users. The phrase "chatbot" is a combination of the words "chat," which refers to its conversational aspect, and "bot," which stands for robot. In this study, the Chatbot is available through the students' Messenger accounts and was built on the ManyChat platform. Chatbots are built to obey specified instructions depending on user input (Colace et al. 2018, 528). They intend to provide responses that are similar to human-like communication (Ischen et al. 2020, 34).

The integration of Chatbot is anchored to mobile learning theory. In mobile learning, students traverse space and time as they progress from topic to topic. Learners engage with technology intermittently, comparable to a hybrid classroom. According to the principle of mobile learning, the learner is mobile—not the technology (Shuler 2009).

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ACTION RESEARCH QUESTIONS

This study aimed to investigate the effects on students' engagement and academic achievement with the integration of Chatbot in an Inquiry-based Approach in Teaching Science to the Grade 8 students at the junior high school department of one of the schools in the Division of Pagadian City. It also discussed the difficulties and issues found when utilizing the innovative intervention. Moreover, it determined the insights gained as the strategy when utilize in the classroom.

It aimed to answer the following questions in particular:

1. What is the level of students' science engagement before and after integrating Chatbot in an Inquiry-based approach in teaching science in the first, second, and third trial runs?
2. What is the level of students' science achievement using Chatbot in an inquiry-based approach as revealed by the pretest and posttest results in the first, second, and third trial runs?
3. Is there a significant difference in students' engagement in science when Chatbot is integrated into an inquiry-based approach in teaching science?
4. Is there a significant difference in students' achievement in science when Chatbot is integrated into an inquiry-based approach in teaching science?

ACTION RESEARCH METHODS

Research Design

This study utilized Quasi-experimental, time series, pretest and posttest, single group design in order to determine the improvement of the students' academic achievement integrating Chatbot in an Inquiry-based approach in teaching Science. With this approach, the impact of the intervention is assessed both before and after the experiment. Single group was employed in this study to ensure the comparison is only between the pretest and posttest results only and the external factors such as individual differences between participants can be minimized.

Participants and Other Sources of Data Information

The study is conducted at the junior high school department of one of the secondary schools of the Division of Pagadian City during the 4th grading period of the school year 2022–2023, utilizing 42 Grade 8 students from Grade 8 Arthropoda were considered participants in this study. In this study, all students were taught using Chatbot in an Inquiry-based approach in teaching science.

Research Instrument

The study used three lesson plans which integrated Chatbot in an Inquiry-based approach in teaching Science and were subjected to validation by the content experts that were master teachers in the division of Pagadian City.

Science competencies and concepts discussions were based on the content standards stipulated in the science curriculum guide. Pre- and post-tests measured students' cognitive and problem-solving proficiencies before the start of the lesson and after the end of the lesson. A Science achievement test developed by the researcher and subjected to validity and reliability testing. Experts in the field of science were asked to judge each question. The Cronbach's alpha value of the tests, after which it was subjected to reliability statistics, is 0.7, which is an acceptable value.

In order to determine the academic achievement level of the students in learning the Science concepts using the Chatbot, the researcher prepared a 15 item Multiple Choice type pretest and posttest in the three (3) lesson plans.

Data Gathering Procedure

The researcher obtained approval from the Office of the Schools Division Superintendent of Pagadian City and Office of the School Principal to carry out the study in the area to ensure the research's validity. The researcher also need permission from the teacher in charge of the class and the head of the science department. Research participants were oriented about the goal and relevance of the study, the risks and benefits of the case study, as well as the fact that the study entailed commitment and the protection of confidentiality, as part of the process for obtaining data. Informed consents were obtained from the participants' parents as part of the preliminary data gathering process. Research participants will complete a Student's Science Engagement Scale (SSES) questionnaire before and after integrating Chatbot in an Inquiry-based approach in teaching science.

Data Analysis

Integrating Chatbot in an Inquiry-based approach in Teaching Science on Science engagement and achievement was processed quantitatively using a descriptive and inferential statistics. To test for the level of significant difference between the pretest and posttest, paired samples t-test was performed. The paired t-test is used in order to test the effects before and after the integration of Chatbot in an Inquiry-based approach in teaching Science. Thus, Science engagement and achievement of the learners were treated as the dependent variables in this exploration.

Processing of the data gathered was done on the computer using the software Statistical Package for Social Sciences (SPSS), which provided for the accurate and reliable computation of the results.

RESULTS AND DISCUSSION

Level of Students' Science Engagement in the First Trial Run.

Table 1 shows the results in determining the students' level of Science Engagement in an Inquiry-based Approach in Teaching Science in first trial run. The overall level of engagement in learning science before Chatbot intervention was observed to be Very High *(M = 3.54; SD = 0.19)*. Similarly, overall level of engagement in integrating Chatbot in an Inquiry-based Approach in learning science was also observed to be Very High *(M = 3.73; SD = 0.13)*.

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Interestingly, item #9 indicated a level of engagement in the pre-intervention interpreted as High while the remaining twenty (20) items posted means interpreted as Very High. On the other hand, only one (1) indicator of students' engagement in the post intervention out of twenty-one (21) posted a mean interpreted as High while other indicators posted means interpreted as Very High. By and large, students' engagement both in pre-intervention and post-intervention showed approximately equivalent level of science engagement in the learning process.

Table 1: Level of Students' Science Engagement in the First Trial Run Before and After the Intervention

Statement	Pre-Implementation			Post-Implementation		
	Mean	SD	Description	Mean	SD	Description
1. My science lessons and performance tasks are important and relevant to my life.	3.37	0.96	Very High	3.63	0.67	Very High
2. My science lessons and tasks in the Chatbot are interesting and meaningful.	3.30	0.95	Very High	3.63	0.62	Very High
3. My science lessons and performance tasks are realistic and contextualized in the Chatbot.	3.57	0.63	Very High	3.70	0.47	Very High
4. I am inspired to learn new things in science class through Chatbot.	3.63	0.56	Very High	3.83	0.38	Very High
5. My science lessons and task in Chatbot stimulate my curiosity.	3.67	0.48	Very High	3.80	0.41	Very High
6. I feel encouraged and interested to work on something in science class with the integration of Chatbot.	3.57	0.68	Very High	3.90	0.31	Very High
7. I am inspired and prepared to come to science class every day with the integration of Chatbot.	3.30	0.95	Very High	3.47	0.78	Very High
8. I am having fun during collaborative learning activities in science with the integration of Chatbot.	3.47	0.73	Very High	3.83	0.46	Very High
9. I want to ask my science teacher or classmates personally or through social media if I have a trouble understanding a lesson.	2.83	1.09	High	3.13	0.82	High
10. I want to investigate and understand the societal and environmental impacts and implications from science and technology.	3.63	0.62	Very High	3.77	0.50	Very High
11. I participate and interact during small-group discussions in Science.	3.60	0.68	Very High	3.77	0.43	Very High
12. I appreciate the nature of scientific method or process.	3.37	0.77	Very High	3.63	0.56	Very High
13. I consult and share my views and knowledge to my classmates and Science teacher.	3.53	0.68	Very High	3.73	0.45	Very High
14. I do and finish my science tasks on time.	3.57	0.63	Very High	3.70	0.54	Very High

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15. I raise my hand to participate in science class discussions.	3.63	0.56	Very High	3.77	0.43	Very High
16. I read and review my modules, class notes, handouts, and textbook between classes to make sure that I learn from these Science learning materials.	3.47	0.78	Very High	3.70	0.54	Very High
17. I prepare thoroughly before the test to be conducted in Chatbot.	3.67	0.61	Very High	3.90	0.31	Very High
18. I give maximum effort to my science class.	3.50	0.68	Very High	3.73	0.52	Very High
19. I always pay attention to my teacher and classmates who communicate during science class.	3.87	0.35	Very High	3.87	0.35	Very High
20. I feel supported by my classmates and science teacher.	3.90	0.31	Very High	3.90	0.31	Very High
21. I follow the instructions closely in doing my science work with the integration of Chatbot.	3.87	0.35	Very High	3.93	0.25	Very High
Weighted Mean	**3.54**	**0.67**	**Very High**	**3.73**	**0.48**	**Very High**

**Scale: 1.00 – 1.75 = Very Low; 1.76 – 2.50 = Low; 2.51 – 3.25 = High; 3.26 – 4.00 = Very High*

Level of Students' Science Engagement in the Second Trial Run. Table 2 shows the results in determining the students' level of Science Engagement in an Inquiry-based Approach in Teaching Science in Second Trial Run. The overall level of engagement in learning science before Chatbot intervention was observed to be Very High *(M = 3.48; SD = 0.19)*. Similarly, the overall level of engagement in integrating Chatbot in an Inquiry-based Approach in learning science was also observed to be Very High *(M = 3.71; SD = 0.12)*.

Interestingly, item #7, item #9 and item #12 indicated a level of engagement in the pre-intervention interpreted as High while the remaining eighteen (18) items posted means interpreted as Very High. On the other hand, only one (1) indicator of students' engagement in the post intervention out of twenty-one (21) posted a mean interpreted as High while other indicators posted means interpreted as Very High.

Table 2: Level of Students' Science Engagement in the Second Trial Run Before and After the Intervention

Statement	Pre-Implementation			Post-Implementation		
	Mean	**SD**	**Description**	**Mean**	**SD**	**Description**
1. My science lessons and performance tasks are important and relevant to my life.	3.53	0.78	Very High	3.53	0.68	Very High
2. My science lessons and tasks in the Chatbot are interesting and meaningful.	3.33	0.84	Very High	3.53	0.63	Very High
3. My science lessons and performance tasks are realistic and contextualized in the Chatbot.	3.50	0.63	Very High	3.60	0.50	Very High
4. I am inspired to learn new things in science class through Chatbot.	3.63	0.56	Very High	3.77	0.43	Very High
5. My science lessons and task in Chatbot stimulate my curiosity.	3.57	0.57	Very High	3.67	0.48	Very High
6. I feel encouraged and interested to work on something	3.43	0.68	Very High	3.77	0.43	Very High

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in science class with the integration of Chatbot.						
7. I am inspired and prepared to come to science class every day with the integration of Chatbot.	3.20	0.93	High	3.47	0.78	Very High
8. I am having fun during collaborative learning activities in Science with the integration of Chatbot.	3.37	0.72	Very High	3.77	0.50	Very High
9. I want to ask my science teacher or classmates personally or through social media if I have a trouble understanding a lesson.	2.77	1.04	High	3.13	0.82	High
10. I want to investigate and understand the societal and environmental impacts and implications from Science and technology.	3.53	0.63	Very High	3.70	0.54	Very High
11. I participate and interact during small-group discussions in Science.	3.53	0.63	Very High	3.87	0.35	Very High
12. I appreciate the nature of scientific method or process.	3.20	0.81	High	3.77	0.43	Very High
13. I consult and share my views and knowledge to my classmates and Science teacher.	3.43	0.68	Very High	3.80	0.41	Very High
14. I do and finish my science tasks on time.	3.47	0.63	Very High	3.60	0.50	Very High
15. I raise my hand to participate in science class discussions.	3.67	0.48	Very High	3.80	0.41	Very High
16. I read and review my modules, class notes, handouts, and textbook between classes to make sure that I learn from these Science learning materials.	3.50	0.78	Very High	3.80	0.48	Very High
17. I prepare thoroughly before the test to be conducted in Chatbot.	3.63	0.56	Very High	3.90	0.31	Very High
18. I give maximum effort to my science class.	3.53	0.51	Very High	3.73	0.45	Very High
19. I always pay attention to my teacher and classmates who communicate during science class.	3.67	0.48	Very High	3.90	0.31	Very High
20. I feel supported by my classmates and science teacher.	3.77	0.43	Very High	3.83	0.38	Very High
21. I follow the instructions closely in doing my science work with the integration of Chatbot.	3.80	0.41	Very High	3.90	0.31	Very High
Weighted Mean	**3.48**	**0.65**	**Very High**	**3.71**	**0.48**	**Very High**

**Scale: 1.00 – 1.75 = Very Low; 1.76 – 2.50 = Low; 2.51 – 3.25 = High; 3.26 – 4.00 = Very High*

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Level of Students' Science Engagement in the Third Trial Run. Table 3 shows the results in determining the students' level of Science Engagement in an Inquiry-based Approach in Teaching Science in trial run 3. The overall level of engagement in learning science before Chatbot intervention was observed to be Very High *(M = 3.56; SD = 0.16)*. Similarly, the overall level of engagement in integrating Chatbot in an Inquiry-based Approach in learning science was also observed to be Very High *(M = 3.76; SD = 0.13)*.

Based on the results, only item #9 indicated a level of engagement in the pre-intervention interpreted as High while the remaining twenty (20) items posted means interpreted as Very High. On the other hand, all indicators of students' Science engagement in the post intervention out of twenty-one (21) posted a mean interpreted as Very High.

Table 3: Level of Students' Science Engagement in the Third Trial Run Before and After the Intervention

Statement	Pre-Implementation			Post-Implementation		
	Mean	SD	Description	Mean	SD	Description
1. My science lessons and performance tasks are important and relevant to my life.	3.50	0.57	Very High	3.77	0.43	Very High
2. My science lessons and tasks in the Chatbot are interesting and meaningful.	3.27	0.79	Very High	3.77	0.43	Very High
3. My science lessons and performance tasks are realistic and contextualized in the Chatbot.	3.70	0.47	Very High	3.80	0.41	Very High
4. I am inspired to learn new things in science class through Chatbot.	3.53	0.57	Very High	3.83	0.38	Very High
5. My science lessons and task in Chatbot stimulate my curiosity.	3.63	0.49	Very High	3.80	0.41	Very High
6. I feel encouraged and interested to work on something in science class with the integration of Chatbot.	3.47	0.63	Very High	3.90	0.31	Very High
7. I am inspired and prepared to come to science class every day with the integration of Chatbot.	3.47	0.68	Very High	3.53	0.51	Very High
8. I am having fun during collaborative learning activities in Science with the integration of Chatbot.	3.60	0.50	Very High	3.83	0.38	Very High
9. I want to ask my science teacher or classmates personally or through social media if I have a trouble understanding a lesson.	2.77	1.04	High	3.60	0.56	Very High
10. I want to investigate and understand the societal and environmental impacts and implications from Science and technology.	3.70	0.54	Very High	3.80	0.48	Very High
11. I participate and interact during small-group discussions in Science.	3.63	0.49	Very High	3.70	0.47	Very High
12. I appreciate the nature of scientific method or process.	3.40	0.68	Very High	3.57	0.57	Very High
13. I consult and share my views and knowledge to my classmates and Science teacher.	3.40	0.68	Very High	3.77	0.43	Very High

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14. I do and finish my science tasks on time.	3.60	0.62	Very High	3.60	0.56	Very High
15. I raise my hand to participate in science class discussions.	3.67	0.55	Very High	3.87	0.35	Very High
16. I read and review my modules, class notes, handouts, and textbook between classes to make sure that I learn from these Science learning materials.	3.63	0.72	Very High	3.63	0.56	Very High
17. I prepare thoroughly before the test to be conducted in Chatbot.	3.60	0.62	Very High	3.90	0.31	Very High
18. I give maximum effort to my science class.	3.63	0.62	Very High	3.63	0.56	Very High
19. I always pay attention to my teacher and classmates who communicate during science class.	3.87	0.35	Very High	3.80	0.41	Very High
20. I feel supported by my classmates and science teacher.	3.90	0.31	Very High	3.90	0.31	Very High
21. I follow the instructions closely in doing my science work with the integration of Chatbot.	3.87	0.35	Very High	3.93	0.25	Very High
Weighted Mean	**3.56**	**0.58**	**Very High**	**3.76**	**0.43**	**Very High**

**Scale: 1.00 – 1.75 = Very Low; 1.76 – 2.50 = Low; 2.51 – 3.25 = High; 3.26 – 4.00 = Very High*

Students' Engagement Using Chatbot in an Inquiry-based Approach in Teaching

By employing Paired Samples T-test, Table 4 indicates the test of significant difference in students' engagement in learning Science before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science during the first, second, and third trial runs.

In the first trial run, the table *(t-value = -9.56; p-value = 0.001)* reveals that there is a high significant difference between the level of students' engagement before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science. In the second trial run, the table *(t-value = -9.40; p-value = 0.001)* reveals that there is a high significant difference between the level of students' engagement before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science. In the third trial run, the table *(t-value = -7.83; p-value = 0.001)* reveals that there is a high significant difference between the level of students' engagement before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science.

Table 4: Test of Significant Difference on Students' Engagement before and after Integrating Chatbot in an Inquiry-based Approach in Teaching Science

Phase		N	mean	sd	df	t-stat	p-value	Description
First Trial Run	Pre-Intervention	30	3.54	0.67	29	-9.56	0.001	Highly Significant
	Post-Intervention		3.73	0.48				
Second Trial Run	Pre-Intervention	30	3.48	0.65	29	-9.40	0.001	Highly Significant
	Post-Intervention		3.71	0.48				
Third Trial Run	Pre-Intervention	30	3.56	0.58	29	-7.83	0.001	Highly Significant
	Post-Intervention		3.76	0.43				

**Significance at 0.05 level*

This finding signifies that students' level of engagement in learning Science has significantly increased through the integrating Chatbot in an Inquiry-based approach in teaching Science. This supports the claim that integrating Chatbot in an Inquiry-based approach enhances students' engagement in the teaching-learning process.

This implication in consistent with the study conducted that the Chatbot had a significant impact on student success and engagement (Lin and Chang 2020, 78).

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Chatbots are one suitable learning method for students to evaluate their prior knowledge and can be used to collect class feedback (Grudin and Jacques 2019, 8). Chatbots, on the other hand, can encourage shy or hesitant students to express questions during a typical class session (Verleger and Pembridge 2018, 2).

Chatbots are therefore a potential option for improving connection and motivation, providing personalized learning, and reducing loneliness and social isolation. It is feasible to pre-program responses to frequently requested questions and deliver immediate responses making it easier for students to ask inquiries and receive immediate answers (Cameron et al. 2017, 2). As a result, Chatbots can help teachers by answering repetitive questions and acting as virtual assistants or tutors for students (Singh 2021, 29). A student in a supportive learning environment that allows them to express their interest and become involved in the learning process will always succeed and engage more than a student who is exposed to less-interactive environment or a lack of stimulation (Dotterer and Lowe 2011).

The Table 5 reflects the pretest and post test scores of the participants for the first trial run of this investigation.

In the first trial run, the pretest mean score was 5.30, suggesting that students initially scored an average of 5.30 out of the total points. The average post-test score was 12.13, indicating a substantial rise in the academic achievement of students. The pretest standard deviation of 1.41 and the post-test standard deviation of 1.72 demonstrate the variability of scores around their respective means. The pretest had the mean variability of around 1.41 points, whereas the post-test had an average variability of about 1.72 points. The t-value of -19.94 with a p-value of 0.001 indicates that the difference between the pretest and post-test scores is highly significant. From the pretest to the post-test, there was a substantial rise in student achievement in science. The post-test scores had a higher mean score, indicating that students performed better in the post-test than in the pretest in the first trial run.

In the second trial run, the pretest had a mean score of 6.03 and a standard deviation of 1.61, indicating that the average score was 6.03. The post-test had a higher mean score of 12.33 and a slightly lower standard deviation of 1.42, indicating that scores had improved. The t-value of -14.96, with a p-value of 0.001, revealed that the difference between the pretest and post-test scores was highly significant.

In the third trial run, the pretest had a mean score of 8.33 and a standard deviation of 1.37, indicating that the initial average score was 8.33 with considerable variability. The post-test had a higher mean score of 13.50 and relatively greater standard deviation of 1.43, indicating that scores improved with partially increased variability. The t-value of -19.65, with a p-value of 0.001, revealed that the difference between the pretest and post-test scores was extremely significant. This provides substantial support against the null hypothesis, implying that the observed difference is unlikely to be the result of random chance. This finding signifies that students' level of achievement in learning Science has significantly increased through the integrating Chatbot in an Inquiry-based approach in teaching Science. This warrants the claim that Chatbot enhance students' achievement in the teaching-learning process.

Table 5: Test of Significant Difference in Academic Achievement Level of Students before (pretest) and after (posttest) integrating Chatbot in an Inquiry-based approach in teaching Science in the First, Second, and Third Trial Runs.

Phase		n	mean	Sd	df	t-stat	p-value	Description
First Trial Run	Pre-Intervention	30	5.30	1.41	29	-19.94	0.001	Highly Significant
	Post-Intervention		12.13	1.72				
Second Trial Run	Pre-Intervention	30	6.03	1.61	29	-14.96	0.001	Highly Significant
	Post-Intervention		12.33	1.42				
Third Trial Run	Pre-Intervention	30	8.33	1.37	29	-19.65	0.001	Highly Significant
	Post-Intervention		13.50	1.43				

**Significance at 0.05 level*

The findings indicate a considerable improvement in student science achievement from the pretest to the posttest. The higher mean post-test score supports this finding, and the statistical significance of the results increases confidence in the observed improvement. This implication in consistent with the study conducted that individualized learning aid provided by Chatbots has a major impact on student learning and enjoyment (Winkler and Söllner 2018) despite the fact that various research on the effective adoption of Chatbots have been conducted (Dutta 2017).

CONCLUSION AND RECOMMENDATIONS

With the significant difference in the students' level of science engagement and academic achievement taught through integrating Chatbot in an Inquiry-based approach in teaching science, then this approach could be used to enhance students' capabilities in understanding science concepts. The null hypothesis is rejected in the conducted three trial runs meaning, the students applied with integrating Chatbot in an Inquiry-based approach in teaching science obtained higher posttest scores.

Based on the results of the study, this concludes that integrating chatbot in an Inquiry-based approach in teaching science results better students' engagement and academic achievement.

It is suggested that teachers may integrate Chatbot in an Inquiry-based approach in the learning process to maximize the students'

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engagement and learning outcomes and enabling teachers to explore new technology similar to Chatbot. It is suggested that other grade level and different subject matter to utilize chatbot to increase engagement and achievement in the learning process.

Since Chatbot can be utilized as a supplementary digital learning tool, it is recommended to further study would be conducted among various levels and subject matter.

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