Chem Lab Mobile Application on Students' Cognitive Learning Outcomes and Performance

Kristelle Myles Gabrang Matienzo

Laguna State Polytechnic University Sta. Cruz Laguna 4009 PHILIPPINES
Email address: kristellematienzo.kmm@gmail.com

Abstract—*The study investigated the relationship and effect of Chem Lab Mobile Application on the Students' Cognitive Learning Outcomes and Performance. Specifically, it aimed to determine the level of Chem Lab in terms of its components, characteristics, students' cognitive learning outcomes, and students' performance. The study also evaluated the significant relationship between the Chem Lab on students' cognitive learning outcomes, as well as the significance difference on student's performance and its significant effect to student's performance. This study utilized a descriptive research design. The instruments used in the study were a questionnaire, rubric, and a 30-item test. To analyze and interpret the data gathered, the researcher utilized weighted mean, standard deviation, Pearson R correlation, T-test, and regression analysis. One hundred (100) randomly selected Grade 8 students from Eduardo Barretto Sr. Integrated School were the respondents of this research. The findings show that the level of Chem Lab mobile application in terms of both components and characteristics was of very high. Similarly, the level of students' cognitive learning outcomes was also perceived to be very high. Furthermore, the results of students' performance in terms of written tests have changed from satisfactory to very satisfactory before and after implementing the Chem Lab while the student's performance in terms of practical tests was deemed to be outstanding. Additionally, a partially significant relationship was found between the Chem Lab and students' cognitive learning outcomes, as a certain indicator doesn't exhibit the same effect to all knowledge domains. Among all the components, only the interactive learning exercises shows significance across all domains. On the other hand, objectives, supplementary videos, and self-paced assessments is significant to conceptual knowledge but not to both factual and metacognitive knowledge, while text-to-speech lessons exhibit no significance in all domains. From the characteristics, accessibility, strategy sequence, user engagement, and user independence are significant to conceptual and metacognitive knowledge but not to factual knowledge. The application design showed no significant relationship to both factual and metacognitive knowledge but significant to conceptual knowledge. An important difference was observed among students' performance in terms of written tests. And lastly, Chem Lab mobile application was evaluated to have no significant effect on the students' performance. Hence, this study offers a comprehensive understanding of how Chem Lab mobile application have components and characteristics that can be used to bridge various learning gaps and to increase the quality of the delivery of the lessons. Also, it offers opportunities for students to take part in different activities that gives them the chance to develop their cognitive learning outcomes in different knowledge dimensions. Its use led to a substantial improvement in students' performance levels showing its effectiveness in facilitating comprehension, retention and cognitive development among students. However, it was also found that there are areas in which the Chem Lab could be refined or modified to maximize its ability to fulfill its purpose. Teachers improve science instruction by creating an interactive and cooperative learning environment that develop the students' abilities and intellects in a wide range. Based on the findings and conclusions, it can be suggested that students can use digital learning tool like Chem Lab mobile application to improve their understanding Chemistry lessons while developing their skills in self-regulated learning guided by teachers. Additionally, teachers may integrate instructional tools like Chem Lab into their discussions to enhance science education that offers interactive activities that develop diverse skills among the students. School heads, on the other hand, can utilize these insights to incorporate digital tools not just in science but across different subjects. Lastly, future researchers may use this study to design another mobile application which further enhance the teaching and learning processes.*

Keywords— *Chem Lab Mobile Application; Learning Outcomes; Performance.*

I. INTRODUCTION

Science subjects explore topics about human life, universe, and the natural world. They help us understand how things work through analysis, observation, and experimentation. The more we gain insights on science, the more we can develop solutions to certain real-life problems. Effective classroom instruction in teaching science involves, crafting activities that encourages the students to ask questions, experiment, create models and simulations, incorporating diagrams and videos, connecting lessons to real-life scenarios, and even integrating digital tools and apps like virtual labs to make learning interactive and accessible.

Educational technology has become a valuable inclusion in the teaching-learning process in the classroom. It has given educators a wide array of tools to craft, develop, and modify the teaching methodologies for them to create a fast-paced continual and interactive learning environment characterized by change, progress, and activity which challenges the students to enhance their prior knowledge and build new practical understanding of concepts. Mobile applications can make learning easy and accessible on just a few clicks of a button. Educational mobile apps are a great tool to use to deliver a lesson that would complement children's interest and education, both in and offside of the classroom. The animations in the mobile applications can help them get more involved and interested in the lesson rather than books or chalkboards. This creates a learner that is highly engaged and participative in the classroom because most of the 21st century learners are tech-savvy. According to the research of Nalinig, et.al (2019), facilitating learning online promotes better results than the traditional textbooks-based learning.

Learning that engages a student to a higher level of mental processes is called cognitive learning. This style of learning focuses on the use and function of the brain. Cognitive learning develops the ability of the student to recall facts and information, understand the concepts, apply ideas to a procedure, and evaluate their own progress metacognitively.

The academic performance of a student measures and evaluates the student's learning achievements and whether the short- and long-term educational goals have been attained. Maximizing student's performance through active engagement and involvement can be achieved by implementing the right strategies that can create a difference benefiting both the students and the teacher.

Thus, the researcher aims to know if using mobile application in teaching selected topics in Chemistry will be beneficial to develop students' cognitive learning outcomes and performance in chemistry class through Chem Lab Mobile Application.

1.1 Statement of the Problem

Specifically aims to answer the following questions:
1. What is the level of Chem Lab Mobile Application in terms of components as to:
    1.1. Objectives;
    1.2. Text-to-speech Lessons;
    1.3. Supplementary Videos;
    1.4. Interactive Learning Exercises; and
    1.5. Self-paced Assessment?
2. What is the level of Chem Lab Mobile Application in terms of characteristics as to:
    2.1. Accessibility;
    2.2. Strategy sequence;
    2.3. Application Design;
    2.4. User Engagement; and
    2.5. User Independence?
3. What is the level of students' cognitive learning outcomes in terms of:
    3.1. Factual Knowledge;
    3.2. Conceptual Knowledge; and
    3.3. Metacognitive Knowledge?
4. What is the level of students' performance in terms of:
    4.1. Written test;
    4.1.1. Diagnostic test; and
    4.1.2. Summative test
    4.2. Practical test?
5. Is there a significant relationship between the level of using Chem Lab on students' Cognitive Learning Outcomes?
6. Is there a significant difference between the level of student's performance in terms of written test as to:
    6.1. Diagnostic test; and
    6.2. Summative test?
7. Is there a significant effect on Chem Lab on students' performance?

II. METHODOLOGY

To fulfill the objectives and aims of the research, the researcher utilized a descriptive research design and focused on finding out the effectiveness of Chem Lab mobile application on students' cognitive learning outcomes and performance. This research design is used to systematically describe characteristics, occurrences, and behaviors without manipulating the study environment. It focuses on collecting and gathering information about a certain condition or situation to describe and interpret it. This research approach involves thorough analysis and comparisons with the purpose of identifying the trends and relationships among variables. (Pimta, 2017).

III. RESULTS AND DISCUSSION

This chapter presents the results, analysis, and interpretation of data that examine the relationship and effect of Chem Lab mobile application on the student's cognitive learning outcomes and performance.

Level of Acceptability of the Components of Chem Lab Mobile Application

The proceeding tables show the presentation, analysis, and interpretation of data on the the level of Chem Lab mobile application in terms of components as to its Objective, Text-to-speech Lessons, Supplementary Videos, Interactive Learning Exercises, and Self-paced Assessment. Through examining and interpreting the data, the researcher aims to gain valuable insights in the acceptability of the Chem Lab as an effective instructional tool. It was statistically measured using mean and standard deviation.

TABLE 1. *Level of Chem Lab mobile application in terms of components as to objective.*

The lesson objectives…	Mean	SD	Remarks
…are clear and well-defined.	4.69	0.46	Strongly Agree
…align with the learning goals of the lesson.	4.53	0.50	Strongly Agree
…indicate what is expected from the students.	4.48	0.50	Strongly Agree
…are achievable within the time frame.	4.55	0.50	Strongly Agree
…motivate the students to learn.	4.78	0.42	Strongly Agree
Weighted Mean	**4.61**		
SD	**0.49**		
Verbal Interpretation	**Very High**		

Table 1 illustrates the level of Chem Lab mobile application in terms of components as to objective.

Most notably, the highest rating (M=4.78, SD=0.42) indicates that the objectives are motivating for students. Additionally, the objectives indicate what is expected from the students (M=4.48, SD=0.50). It indicates that the objectives are rated highly across several criteria, with a weighted mean of 4.61, an overall standard deviation of 0.49, and the verbal interpretation, "Very High". This data strongly supports the conclusion that objectives are exemplary in meeting educational standards.

TABLE 2. *Level of Chem Lab mobile application in terms of components as to text-to speech lessons.*

The text-to-speech lesson (audio)...	Mean	SD	Remarks
...is clear and easy to understand.	4.64	0.50	Strongly Agree
...enhanced my understanding of the lesson.	4.56	0.50	Strongly Agree
...helps me follow along with the lesson content.	4.57	0.50	Strongly Agree
...are engaging and keep my attention.	4.54	0.52	Strongly Agree
...is appropriate to my reading speed.	4.53	0.52	Strongly Agree
Weighted Mean		**4.57**	
SD		**0.51**	
Verbal Interpretation		**Very High**	

Table 2 depicts the level of Chem Lab Mobile Application in terms of components as to text-to-speech.

The text-to-speech lessons is rated highest (M= 4.64, SD=0.50) for being easy to understand. Although slightly lower (M=4.53, SD=0.52) indicates that TTS lesson is appropriate to the reading speed of the learners. This emphasizes the value of delivering the lesson in ways that promotes engaging learning experience. The evaluation of the text-to-speech lesson demonstrates positive feedback with a weighted mean of 4.57, a standard deviation of 0.51, and interpreted as "Very High", the results indicate that the audio is perceived as highly effective and well-received.

TABLE 3. *Level of Chem Lab mobile application in terms of components as to Supplementary videos*

The supplementary videos...	Mean	SD	Remarks
...are related to the lesson.	4.74	0.44	Strongly Agree
...have good audio and clear animations.	4.64	0.48	Strongly Agree
...explain complex concepts of the lesson.	4.55	0.50	Strongly Agree
...enhance my understanding of the lesson.	4.60	0.49	Strongly Agree
...engaging and keep my attention.	4.53	0.50	Strongly Agree
Weighted Mean		**4.61**	
SD		**0.49**	
Verbal Interpretation		**Very High**	

Table 3 demonstrates the level of Chem Lab mobile application in terms of components as to supplementary videos.

TABLE 4. *Level of Chem Lab Mobile Application in terms of components as to Interactive Learning Exercises*

The learning exercises...	Mean	SD	Remarks
...helps me understand the lesson.	4.75	0.46	Strongly Agree
...are challenging and stimulating.	4.63	0.49	Strongly Agree
...provide immediate feedback by showing my correct and wrong answers.	4.66	0.48	Strongly Agree
...cover different aspects of the lesson.	4.56	0.56	Strongly Agree
...are enjoyable and fun to answer.	4.81	0.39	Strongly Agree
Weighted Mean		**4.68**	
SD		**0.48**	
Verbal Interpretation		**Very High**	

The supplementary videos got high ratings from various aspects. It is rated highest (M=4.74, SD= 0.44) as being related to the lesson. Also, the supplementary videos are found to be engaging and maintains the attention of the learners as it is also rated high (M=0.53 SD=0.50). This data emphasizes that the learners strongly believe that the videos are effective in reinforcing learning. The overall weighted mean of 4.61 with a standard deviation of 0.49, and verbal interpretation of "Very High" indicates the totality of the effectiveness and quality of the supplementary videos in enhancing the learning experiences and supporting the lesson content.

Table 4 shows the level of Chem Lab mobile application in terms of its components as to interactive learning exercises.

The interactive learning exercises of the Chem Lab mobile application was deemed to help the students understand the lesson more as it is rated high (M=4.75, SD=0.46). Furthermore, the learning exercises also cover different aspects of the lesson (M=4.56, SD=0.56). This reveals that the learning exercises do not just facilitates the learning and covers various aspects but were also challenging and enjoyable for the learners. The weighted mean of 4.68 with a standard deviation of 0.48 further supports a "Very High" verbal interpretation reflects a positive perception for it among the students. This indicates that the interactive learning exercises have a positive impact on the learning experiences and play a significant role in supporting the content of the lesson.

Table 5 proves the level of acceptability of Chem Lab in terms of components as to self-paced assessments.

The data shows that self-paced assessments are rated high in motivating the students to improve their knowledge (M=4.72, SD=0.45). Additionally, it also covers all the necessary topics of the lesson (M=4.54, SD= 0.54). This indicates that self-paced assessments are rated high by the learners as it allows them to work at their own speed and get immediate feedback.

TABLE 5. *Level of Chem Lab mobile application in terms of components as to Self-paced assessment.*

The self-paced assessments...	Mean	SD	Remarks
...allow me to answer at my speed.	4.56	0.52	Strongly Agree
...cover all necessary topics of the lesson	4.54	0.54	Strongly Agree
...provide immediate feedback by showing my correct and wrong answers.	4.59	0.49	Strongly Agree
...motivate me to improve my knowledge.	4.72	0.45	Strongly Agree
...is easy to navigate.	4.59	0.49	Strongly Agree
Weighted Mean		**4.60**	
SD		**0.50**	
Verbal Interpretation		**Very High**	

In summary, the self-paced assessment got an overall weighted mean of 4.60 accompanied by a standard deviation of 0.50 which reflects a verbal interpretation as "Very High". This denotes that the level of self-paced assessments is promising. Self-paced assessments serve as a valuable tool in providing an engaging and motivating learning environment while taking into considerations the learner's individual pacing and preferences.

Table 6 displays the level of Chem Lab Mobile Application in terms of components.

The data presented in the table showed that all the components of the Chem Lab were rated high with a mean ranging from 4.57 to 4.68 accompanied with a standard deviation ranging from 0.48 to 0.51. It arrived at a grand mean score of 4.61 and a standard deviation of 0.49 and was verbally interpreted as "Very High" among the respondents.

TABLE 6. *Composite table in the level of Chem Lab mobile application in terms of components*

Indicators	Weighted Mean	SD	Remarks
Objective	4.61	0.49	Very High
Text-to-speech Lessons	4.57	0.51	Very High
Supplementary Videos	4.61	0.49	Very High
Interactive Learning Exercises	4.68	0.48	Very High
Self-paced Assessment	4.60	0.50	Very High
Grand Mean	**4.61**		
SD	**0.49**		
Verbal Interpretation	**Very High**		

This means that the Chem Lab Mobile Application in terms of components are highly acceptable and was able to fulfill its purpose of increasing the quality and enhancing the teaching and learning process. It also indicates that each component can be effectively used as an instructional tools and resources that not only meet but exceed expectations, which makes them an essential contributor to a productive and enjoyable learning environment.

Level of Acceptability of the Characteristics of Chem Lab Mobile Application

The tables that follow show the presentation, analysis, and interpretation of data concerning the level of acceptability of Chem Lab Mobile Application in terms of characteristics which, in this study, refers to Accessibility, Strategy Sequence, Application Design, User Engagement, and User Independence. Through examining and analyzing the data related to its characteristics, the researcher aims to know and measure the acceptability of the Chem Lab mobile application as an effective instructional tool which covers a wide range of characteristics. It was statistically measured using mean and standard deviation

TABLE 7. *Level of Chem Lab Mobile Application in terms of characteristics as to Accessibility*

The Chem Lab mobile app can be…	Mean	SD	Remarks
…used easily.	4.74	0.46	Strongly Agree
…installed and used in various devices.	4.44	0.72	Strongly Agree
…used without consuming internet data.	4.62	0.51	Strongly Agree
…used by users with different learning styles.	4.56	0.57	Strongly Agree
…accessed without difficulty.	4.57	0.59	Strongly Agree
Weighted Mean	**4.59**		
SD	**0.58**		
Verbal Interpretation	**Very High**		

Table 7 proves the level of Chem Lab mobile application in terms of characteristics as to accessibility.

The highest mean score (M=4.74, SD=0.46) was given to the indicator which tells the ease of use of Chem Lab, indicating it employs a user-friendly system. Although slightly lower, the score (M=4.44, SD=0.72) for its ability to be installed and used in various devices still reflects positive feedback but this may indicate a need for a minor improvement

The combined weighted mean of 4.59 with a standard deviation of 0.58 is verbally interpreted as "Very High" in terms of the app's overall acceptability in delivering a positive experience to its users with varied needs and preferences. These results confirm that the app can be a reliable and accessible learning tool and educational resource.

TABLE 8. *Level of Chem Lab mobile application in terms of characteristics as to Strategy sequence*

The strategy used in the app…	Mean	SD	Remarks
…are effective.	4.75	0.44	Strongly Agree
…supports different learning styles.	4.60	0.49	Strongly Agree
…helps me have a better understanding of the lesson.	4.65	0.48	Strongly Agree
…encourage active learning.	4.63	0.49	Strongly Agree
…are aligned with the learning objectives.	4.56	0.50	Strongly Agree
Weighted Mean	**4.64**		
SD	**0.48**		
Verbal Interpretation	**Very High**		

Table 8 presents the level of Chem Lab Mobile App in terms characteristics as to strategy sequence.

From the data collected, it was found that the app's strategy is highly effective in reinforcing learning among the users (M=4.75, SD=0.44). Furthermore, the strategy used in the app are aligned with the learning objectives (M=4.56, SD=0.50). This reveals that the strategies used in Chem Lab are effective, cater to various learning styles, increase understanding, encourage active learning, and align with the learning objectives.

The weighted mean of 4.64 along with the standard deviation of 0.48 proposed a "Very High" of acceptability and can only mean that the strategy sequence used in the Chem Lab is acceptable and can be implemented in the classroom settings fostering a supportive and positive learning environment They significantly contribute to enhancing users' comprehension, enjoyment, and alignment with the educational goals.

Table 9 implies the level of acceptability of Chem Lab Mobile Application in terms of characteristics as to its application design.

The evaluation of the app's design imposed a highly favorable perception among the learners. The highest score (M=4.64, SD=0.54) was given for "facilitates easy navigation and use" highlighting the app design's user-friendliness. Meanwhile, the lowest score (M=4.50, SD=0.54) for being visually appealing, though still strong, is indicative for an area of minor aesthetic improvement. This data reflects the Chem Lab as a visually appealing, intuitive, enhances the learning

experience, has color scheme and fonts that are pleasing to the eyes, and facilitates easy navigation.

TABLE 9. *Level of Chem Lab mobile application in terms of characteristics as to Application design*

The design of the app...	Mean	SD	Remarks
...is visually appealing.	4.50	0.54	Strongly Agree
...well-organized and intuitive.	4.61	0.49	Strongly Agree
...enhances the learning experience.	4.62	0.49	Strongly Agree
...like color scheme and fonts are pleasant to the eyes.	4.53	0.52	Strongly Agree
...facilitates easy navigation and use.	4.64	0.54	Strongly Agree
Weighted Mean	**4.58**		
SD	**0.52**		
Verbal Interpretation	**Very High**		

The weighted mean of 4.58 accompanied with a standard deviation of 0.52 can be verbally interpreted as "Very High". This indicates that the Chem Lab Mobile Application is acceptable and very satisfactory in supporting the learning process by being functional and visually engaging, making it a promising and potential tool for increasing the learning experience for the learners.

Table 10 denotes the level of Chem Lab Mobile Application in terms of characteristics as to user engagement.

The user-engagement of Chem Lab got a high mark in various aspects indicating a positive user experience. Navigating through the app keeps the learners engaged throughout the lesson (M=4.69, SD=0.46). This reflects the app's ability to keep users' interest and focus. Similarly, the app gained positive feedback for being able to enhance the learning experience of its users (M=4.55 SD=0.52). There is strong agreement that the app provides enjoyment, stimulation, keeps the learners motivated, and fosters excitement about the subject.

TABLE 10. *Level of Chem Lab mobile application in terms of characteristics as to User engagement*

Navigating through the Chem Lab app...	Mean	SD	Remarks
...keeps me engaged throughout the lesson.	4.69	0.46	Strongly Agree
...enhances the learning experience.	4.55	0.52	Strongly Agree
...is enjoyable and stimulating.	4.67	0.47	Strongly Agree
...encourages me to spend more time on studies.	4.57	0.52	Strongly Agree
...makes me excited in the subject.	4.67	0.47	Strongly Agree
Weighted Mean	**4.63**		
SD	**0.49**		
Verbal Interpretation	**Very High**		

The weighted mean of 4.63 and a standard deviation of 0.49 reflects a verbal interpretation of "Very High". This promotes that navigating through the Chem Lab is enjoyable, engaging, and enriching for the students, significantly affecting their enthusiasm and understanding of the subject matter.

Table 11 implies the level of acceptability of Chem Lab Mobile Application in terms of characteristics as to its user independence.

TABLE 11. *Level of Chem Lab mobile application in terms of characteristics as to User Independence*

The Chem Lab mobile app...	Mean	SD	Remarks
...can be used independently without much help from others	4.58	0.50	Strongly Agree
...makes me confident in using it on my own.	4.61	0.49	Strongly Agree
...allows me to learn at my own pace.	4.68	0.47	Strongly Agree
...makes me a more self-directed learner.	4.61	0.49	Strongly Agree
...allows me to take control of my own learning.	4.71	0.46	Strongly Agree
Weighted Mean	**4.64**		
SD	**0.48**		
Verbal Interpretation	**Very High**		

The data from evaluating the user independence of Chem Lab Mobile Application in various perspectives shows a promising result. The app can be deemed as a tool with high potential that allows learners to take control of their own learning (M=4.71, SD=0.46). Moreover, it upholds the learners' independence as they can navigate through the app without asking for much help from others (M=4.58, SD=0.50). This shows the importance of teaching strategies that provide opportunities for the learners to take charge of their own learning and making them more confident to accomplish things independently as they navigate through the learning process.

The level of Chem Lab Mobile Application in terms of characteristics as to user independence conquered a weighted mean of 4.64 with a standard deviation of 0.48 and verbally interpreted as "Very High" among the respondents. This indicates that the effects of active learning and the ability of the students to take responsibility for their own learning process. As they go through the various stages of the learning process, it is important to implement strategies that make learners grow into independent, motivated, and confident individuals.

TABLE 12. *Composite table on the level of Chem Lab mobile application in terms of characteristics*

Indicators	Weighted Mean	SD	Remarks
Accessibility	4.59	0.68	Very High
Strategy sequence	4.64	0.48	Very High
Application Design	4.58	0.52	Very High
User Engagement	4.63	0.49	Very High
User Independence	4.64	0.48	Very High
Grand Mean	**4.62**		
SD	**0.53**		
Verbal Interpretation	**Very High**		

Table 12 reveals the level of Chem Lab Mobile Application in terms of characteristics as to Accessibility, Strategy sequence, Application Design, User Engagement**,** and User Independence.

The data presented in the table showed that all the characteristics of the Chem Lab are rated high and gained positive feedback by the respondents with a mean ranging

from 4.58 to 4.64 accompanied with a standard deviation ranging from 0.48 to 0.68. It arrived at a grand mean score of 4.62 and a standard deviation of 0.53 and was verbally interpreted as "Very High" among the respondents.

This signifies that the Chem Lab mobile application has characteristics that make it highly acceptable and accomplish its goal of improving the quality of teaching and learning experience for both the teacher and learners. Moreover, it shows that the app has characteristics that support the learning goals and endeavors set by the teacher. It helps in creating and providing opportunities to achieve inclusiveness in education and overcoming some barriers that prevent the students from learning the lessons all while keeping them engaged and motivated throughout the lesson.

Level of Students' Cognitive Learning Outcome

The following tables denote the presentation, analysis, and interpretation of data with regards to the students' cognitive learning outcome which encompasses various dimensions, including factual knowledge, conceptual knowledge, and metacognitive knowledge. Through the analysis of the data collected, the researcher sought to understand students' cognitive growth and achievements across various educational contexts. It was statistically measured using mean and standard deviation.

Table 13 presents the level of students' cognitive learning outcomes in terms of factual knowledge.

Findings exhibit that the Chem Lab helps students develop the skill to label diagrams with correct details (M=4.65, SD=0.48). Conversely it involves presenting opportunities for the students to identify the correct and wrong statements (M=4.55, SD=0.52). This finding underscores the importance of presenting activities to learners where they will be able to recognize specific details or pieces of information as these will be the foundation for higher-order thinking, allowing them to progress into conceptual, procedural, and ultimately metacognitive knowledge.

TABLE 13. *Level of students' cognitive learning outcomes in terms of factual knowledge*

Chem Lab mobile app helps me to:	Mean	SD	Remarks
...recall the definition of terms.	4.57	0.50	Strongly Agree
...identify the correct and wrong statement.	4.55	0.52	Strongly Agree
...interpret and give examples from the knowledge gain.	4.62	0.49	Strongly Agree
...give specific details to complete a statement.	4.56	0.50	Strongly Agree
...label diagrams with correct details.	4.65	0.48	Strongly Agree
Weighted Mean	**4.59**		
SD	**0.50**		
Verbal Interpretation	**Very High**		

The level of students cognitive learning outcome in terms of factual knowledge attained a weighted mean score of 4.59 and a standard deviation of 0.50 and was "Very High" among the respondents. This implies that it is important to develop the factual knowledge of the learners as it is the foundation of all learnings enabling the learners to navigate through the

different academic barriers and tackle real-world situations with confidence.

TABLE 14. *Level of students' cognitive learning outcomes in terms of conceptual knowledge*

Chem Lab mobile app helps me to:	Mean	SD	Remarks
...compare and contrast ideas.	4.54	0.52	Strongly Agree
...be able to relate concepts from one another.	4.45	0.50	Strongly Agree
...apply a concept to a new situation.	4.47	0.56	Strongly Agree
...understand the whole idea of the concept given.	4.55	0.52	Strongly Agree
...create visual representations of a concept.	4.56	0.57	Strongly Agree
Weighted Mean	**4.51**		
SD	**0.54**		
Verbal Interpretation	**Very High**		

Table 14 verifies the level of students' cognitive learning outcome in terms of conceptual knowledge.

It emphasizes that Chem Lab highly value activities that allow students to create visual representations of a concept (M=4.56, SD=0.57). On the other hand, although it is a little lower, which may signify an area of improvement, Chem Lab involves relating concepts from one another. (M=4.45, SD=0.50). Findings emphasize the significance of incorporating experiential learning opportunities into instructional practices, as they involve understanding the relationships between ideas and integrating them into a broader context.

The level of students' cognitive learning outcome in terms of conceptual knowledge upon using the Chem Lab reached a weighted mean score of 4.51 and a standard deviation of 0.54 and was verbally interpreted as "Very High" among the respondents. It implies the importance of honing the students' skills in grasping abstract concepts, understanding the underlying principles, and connecting them across different areas as these can be used to think critically and solve real-life problems more effectively.

TABLE 15. *Level of students' cognitive learning outcomes in terms of metacognitive knowledge*

Chem Lab mobile app helps me to:	Mean	SD	Remarks
...learn the topic at my speed or pacing.	4.48	0.56	Strongly Agree
...make different ways of learning approach that can fits own learning habits.	4.50	0.54	Strongly Agree
...take notes of my mistakes and learn from it.	4.70	0.48	Strongly Agree
...monitor my progress in learning.	4.54	0.52	Strongly Agree
...understand the knowledge about the learning itself.	4.64	0.48	Strongly Agree
Weighted Mean	**4.57**		
SD	**0.52**		
Verbal Interpretation	**Very High**		

Table 15 illustrates the level of students' cognitive learning outcome in terms of metacognitive knowledge.

Findings indicate that Chem Lab highly value students' ability to take notes of their mistakes and learn from it (M=4.70, SD=0.48). Likewise, it includes learning the topic at

their own speed and pacing (M=4.48, SD=0.56). Overall, these findings underscore the importance of developing the students' understanding of their own thinking and learning process, as these aspects can enhance self-awareness and self-regulation.

The level of students' cognitive learning outcome in terms of metacognitive knowledge accomplished a weighted mean score of 4.57 and a standard deviation of 0.52 and was verbally interpreted as "Very High" among the respondents. This entails the significance of empowering students to control their own learning processes, strategies, and decision-making as these are essential components of cognitive development and academic achievement.

TABLE 16. *Composite table on the level of Students' Cognitive Learning Outcomes*

Indicators	Weighted Mean	SD	Remarks
Factual Knowledge	4.59	0.50	Very High
Conceptual Knowledge	4.51	0.54	Very High
Metacognitive Knowledge	4.57	0.52	Very High
Grand Mean	**4.56**		
SD	**0.52**		
Verbal Interpretation	**Very High**		

Table 16 discloses the level of Chem Lab mobile application in terms of cognitive learning outcomes as to Factual knowledge, Conceptual knowledge, and Metacognitive knowledge.

The data represented in the table affirms that all the level of indicators of students' cognitive learning outcomes upon using the Chem Lab are rated positively by the respondents, arriving at mean ranging from 4.51 to 4.59 with a standard deviation ranging from 0.50 to 0.54. The grand mean score of 4.56 and a standard deviation of 0.52 has a verbal interpretation of "Very High".

This imposes that upon implementing the Chem Lab, the students have demonstrated a strong level of knowledge acquisition across different dimensions such as recalling and recognizing details through developing factual knowledge, understanding concepts and relationships through their conceptual knowledge, and being aware of their own learning processes and strategies through their metacognitive knowledge, indicating a well-rounded and effective learning experience among the learners.

Level of Students' Performance

The proceeding tables indicate the presentation, analysis, and interpretation of data pertaining to students' performance which encompasses their academic performances in both written and practical tests. The written tests are measured through the diagnostic and summative tests. Through meticulous analysis of the data collected, the researcher aims to gain insights on students' cognitive development and academic achievements across the different performance indicators. It was statistically measured using mean and standard deviation.

Table 17 proves the level of student's performance in written test as to diagnostic test.

The evaluated data is gathered prior to the implementation of Chem Lab in teaching the lessons in Chemistry. Out of total number of one hundred respondents "7 to 12" and "13 to 18" received the highest frequency of thirty-eight (38) or 38.00% of the total population with descriptive equivalent of Fairly Satisfactory and Satisfactory, respectively. The scores "19 to 24" received the frequency of fifteen (15) or 15.00% of the total population with descriptive equivalent of Very Satisfactory. On the other hand, the scores "0 to 6" received the frequency of seven (7) 02 7.00% of the total population with descriptive equivalent of Did Not Meet Expectations. While the scores "25 to 30" received the lowest frequency of two (2) or 2.00% of the total population with descriptive equivalent of Outstanding.

TABLE 17. *Level of students' performance in written test as to diagnostic test.*

Score	Diagnostic Test		Descriptive Equivalent
	f	%	
25 - 30	2	*2.00*	Outstanding
19 - 24	15	*15.00*	Very Satisfactory
13 - 18	38	*38.00*	Satisfactory
7 - 12	38	*38.00*	Fairly Satisfactory
0 - 6	7	*7.00*	Did not meet Expectation
Total	**100**	*100*	
Weighted Mean	13.63		
SD	4.913		
Verbal Interpretation	*Satisfactory*		

Overall, the level of students' performance in terms of written test as to the diagnostic test accomplished a grand mean score of 13.63 and a standard deviation of 4.913 which indicates a verbal interpretation of Satisfactory among the respondents. This signifies that there is much room or area for improvement but also recognizing areas of strength in students' performance prior to the implementation of Chem Lab Mobile Application.

TABLE 18. *Level of students' performance in written test as to summative test.*

Score	Summative Test		Descriptive Equivalent
	f	%	
25 - 30	29	*29.00*	Outstanding
19 - 24	41	*41.00*	Very Satisfactory
13 - 18	24	*24.00*	Satisfactory
7 - 12	6	*6.00*	Fairly Satisfactory
0 - 6	0	*0.00*	Did not meet Expectation
Total	**100**	*100*	
Weighted Mean	20.98		
SD	4.697		
Verbal Interpretation	*Very Satisfactory*		

Table 18 signifies the level of student's performance in written test as to summative test.

The evaluated data is gathered after the implementation of Chem Lab in teaching the lessons in Chemistry. Out of total number of one hundred respondents "19 to 24" received the highest frequency of forty-one (41) or 41.00% of the total population with descriptive equivalent of Very Satisfactory. The scores "25 to 30" received the frequency of twenty-nine (29) or 29.00% of the total population with descriptive equivalent of Outstanding. On the other hand, the scores "13 to 18" received the frequency of twenty-four (24) or 24.00% of the total population with descriptive equivalent of satisfactory. While the scores "7 to 12" received the lowest

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frequency of six (6) or 6.00% of the total population with descriptive equivalent of Fairly Satisfactory.

Overall, the level of students' performance in terms of written test as to the summative test arrived at a grand mean of 20.98 and a standard deviation of 4.697 indicates a verbal interpretation of Very Satisfactory among the respondents. It denotes that students got higher scores after using the Chem Lab mobile application in the lesson which indicates that the app helped them comprehend the lesson more effectively and was able to retain details and information about the concepts taught.

TABLE 19. *Level of Students' Performance in Practical Test.*

Indicators	Weighted Mean	SD	Remarks
Safety Practices	4.72	0.57	Outstanding
Lab Skills	4.65	0.60	Outstanding
Observations	4.88	0.44	Outstanding
Analysis	4.71	0.56	Outstanding
Conclusions	4.37	0.64	Outstanding
Grand Mean		4.56	
SD		0.52	
Verbal Interpretation		Outstanding	

Table 19 reflects the level of students' performance in terms of practical tests.

The evaluated data provides an overview of students' performance in terms of practical tests that cover various aspects and laboratory activity related indicators, as reflected by their respective weighted means and standard deviation. The students show skills in making observations during the practical tests as this indicator received the highest mean score (M=4.88, SD=0.44). This is followed by the mean score of Safety Practices (M=4.72, SD=0.57), highlighting the skills of the students in following safety protocols while doing the laboratory works. Similarly, "Analysis" gained positive score (M= 4.71, SD=0.56), indicating the skills of the students to correctly interpret data from their observations. Moreover, the indicator "Lab Skills" showed that students are inclined in using laboratory equipment and conducting experiments accurately (M=4.65, SD=0.60). The last indicator, "Conclusions", while slightly lower (M= 4.37, SD=0.64) still reflects a good score, indicating that there is an area for improvement.

The level of students' performance in terms of practical test arrived at a grand mean score of 4.56 and a standard deviation of 0.52 and was verbally interpreted as "Outstanding" among the respondents. This imposes that the students exhibited a high level of skills and proficiency upon accomplishing the different practical tests across the evaluated areas.

Test of relationship between using Chem Lab mobile application on students' Cognitive Learning Outcomes

The following table exhibits the presentation, analysis, and interpretation of data that demonstrates if there is a significant relationship that exists between and among the Chem Lab in terms of components and characteristics on students' cognitive learning outcomes. It was treated statistically using the Pearson product moment correlation coefficient.

Table 20 shows the significant relationship between the Chem Lab in terms of its components and characteristics to students' cognitive learning outcomes.

The Chem Lab Mobile Application in terms of components and characteristics shows a partial significant relationship to the students' cognitive learning outcomes in terms of factual knowledge, conceptual knowledge, and metacognitive knowledge since an indicator does not have the same effect to each of the three cognitive learning outcomes.

Among all the components of the Chem Lab Mobile App, only the interactive learning exercises are deemed to be the most effective which shows a significant relationship across all knowledge domains, underscoring their comprehensive impact on cognitive development. On the other hand, objectives, supplementary videos, and self-paced assessments positively influence conceptual knowledge but does not exhibit significant relations to both factual and metacognitive knowledge, while text-to-speech lessons exhibit no significant relationships across any domain, indicating this feature may not strongly influence these learning outcomes.

From the various characteristics of the Chem Lab Mobile Application, accessibility, strategy sequence, user engagement, and user independence present a positive role in developing the students' conceptual and metacognitive knowledge while showing no significant relationship to factual knowledge. Furthermore, the application design showed no significant relationship to both and metacognitive knowledge but has proven to affect the formation and development pf conceptual knowledge.

These finding can give insights that will guide the refinement or modifications in the components and characteristics of the Chem Lab mobile application to focus on interactive and engaging components that align with effective teaching strategies.

Significant difference between the students' performance in terms of written test

The proceeding tables exhibit the presentation, analysis, and interpretation of data pertaining to significant difference before and after using the Chem Lab mobile application to the student's performance in terms of written exam as to the diagnostic and summative test. The data were treated statistically through real statistics data analysis tools using the Test of difference.

Table 21 shows the test of difference between the students' performance in terms of written test.

The table establishes the results of a test of difference between the levels of student's performance in terms of written test before and after using the Chem Lab mobile application. Before the implementation, the mean performance score was 13.63 with a standard deviation of 4.913. After the implementation, the mean performance score increased to 20.98 with a standard deviation of 4.697. The mean difference between the diagnostic and summative test scores was 7.35, with a 95% confidence interval ranging from 22.060 to 24.134. The calculated t-value was 18.464, with 99 degrees of freedom, and the significance level (2-tailed) was found to be 0.000, indicating a highly significant improvement in

performance after implementing and using the Chem Lab mobile application to the teaching and learning process. This implies that the use of the Chem Lab has led to a substantial improvement in students' performance levels.

TABLE 20. *Significant relationship between the Chem Lab in terms of components, characteristics to students' cognitive learning outcomes.*

Chem Lab Mobile Application		Students' Cognitive Learning Outcomes		
		Factual Knowledge	Conceptual Knowledge	Metacognitive Knowledge
COMPONENTS				
Objective	Pearson Correlation	0.4978	0.5585	0.5395
	Significance (2-Tailed)	0.6095	0.0030	0.2696
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Not Sig*
Text-to-speech Lessons	Pearson Correlation	0.6217	0.5621	0.6893
	Significance (2-Tailed)	0.4336	0.0845	0.8776
	N	199	199	199
	Analysis	*Not Sig*	*Not Sig*	*Not Sig*
Supplementary Videos	Pearson Correlation	0.4899	0.4120	0.5758
	Significance (2-Tailed)	0.4814	0.0055	0.1728
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Not Sig*
Interactive Learning Exercises	Pearson Correlation	0.4080	0.3926	0.4875
	Significance (2-Tailed)	0.0067	0.0000	0.0008
	N	199	199	199
	Analysis	*Sig*	*Sig*	*Sig*
Self-paced Assessment	Pearson Correlation	0.5595	0.5368	0.6644
	Significance (2-Tailed)	0.7418	0.0083	0.3017
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Not Sig*
CHARACTERISTICS				
Accessibility	Pearson Correlation	0.5678	0.5248	0.6292
	Significance (2-Tailed)	0.1343	0.0010	0.0397
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Sig*
Strategy Sequence	Pearson Correlation	0.4838	0.3608	0.5113
	Significance (2-Tailed)	0.1343	0.0010	0.0397
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Sig*
Application Design	Pearson Correlation	0.6001	0.6701	0.6468
	Significance (2-Tailed)	0.7313	0.0168	0.7744
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Not Sig*
User Engagement	Pearson Correlation	0.6655	0.6325	0.6250
	Significance (2-Tailed)	0.1234	0.0000	0.0402
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Sig*
User Independence	Pearson Correlation	0.6571	0.5332	0.5886
	Significance (2-Tailed)	0.0735	0.0002	0.0285
	N	199	199	199
	Analysis	*Not Sig*	*Sig*	*Sig*

TABLE 21. *Test of Difference on the student's performance in terms of students' written exam*

Student's performance	M	SD	Mean Difference	95% Confidence Interval of Difference		t	df	Sig (2-tailed)
				L	U			
Diagnostic test	13.63	4.913	7.35	22.060	24.134	18.464	99	0.000
Summative test	20.98	4.697						

*Legend: *Significant at 0.05*

These results highlight the effectiveness of the Chem Lab in facilitating comprehension, retention and cognitive development among students, highlighting its potential as a valuable instructional tool and educational resource. By delivering lessons using Chem Lab, teachers can better cater to different learning styles with multimedia resources and simplifies instructional delivery and allows personalized teaching. Also, features such as gamification can create an environment that fosters innovation in students' learning experiences.

Significant effect between the Chem Lab mobile application and the students' performance

The following table shows the presentation, analysis, and interpretation of data which refers to the significant effect of Chem Lab mobile application on the student's performance in terms of written test and practical test. The data were treated statistically through real statistics data analysis tools using real statistics data analysis tools using the regression analysis.

TABLE 22. *Test of effect on using Chem Lab Mobile Application and students' performance.*

Chem Lab Mobile Application	Performance	Beta Coefficient	T-value	P-value
Components	Written	3.8902	1.1971	0.2342
	Practical	-0.184	-0.831	0.4079
Characteristics	Written	1.5521	0.5227	0.6024
	Practical	0.068	0.3368	0.737

For components, written test achieved a beta coefficient of 3.8902 with a calculated T-value of 1.1971 and P-value of 0.2342 while practical test accomplished a beta coefficient of -0.184, T-value of -0.83,1 and a P-value of 0.4079. Characteristics, on the other hand, got a beta coefficient of 1.5521, T-value of 0.5227, and a P-value of 0.6024 for written tests while a beta coefficient of 0.068, T-value of 0.3368, and P-value of 0.737 was calculated for practical tests. The data shows that all the calculated P-values were greater than 0.05 level of significance. This indicates that neither the components nor the characteristics of the Chem Lab mobile application have a statistically significant effect to both written and practical tests of the students.

This underscores that though the Chem Lab shows potential, the results shows that the evidence are not strong enough to indicate its impact on students' performance. The features of Chem Lab may benefit certain learning styles more than the others, highlighting the areas for improvement to maximize its effectiveness. This mean that the Chem Lab could be refined further to address and targets specific aspects of performance among the students with varied learning styles and approach.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the foregoing findings, the following conclusions were drawn.
1. The study shows a partial significant relationship between the Chem Lab mobile application and the students' cognitive learning outcomes. Thus, resulting to partial rejection of the null hypothesis. These findings underscore the importance of utilizing Chem Lab mobile application as an effective framework for promoting knowledge acquisition and enhancing students' cognitive learning outcomes. However, it can also be subjected to further refinement to maximize its potential.
2. Additionally, the study shows significant difference in students' performance in terms of written test as to diagnostic and summative test upon using Chem Lab mobile application. Thus, null hypothesis was rejected. These results underscore the effectiveness of using Chem Lab mobile application in enhancing student's performance. This shows that integrating a mobile application into educational settings can lead to notable improvements in student learning outcomes.

3. Lastly, the research reveals that Chem Lab mobile application has no significant effect on the students' performance. Thus, the null hypothesis was accepted. This means that the Chem Lab mobile application does not reach its maximum potential in enriching the classroom instruction, highlighting its areas for improvement. The app cannot accommodate other learning styles. It is important that the app undergo further refinement to target different aspects of students' performance.

Based on the findings and conclusions drawn, the following were recommended:
1. Students may use Chem Lab to increase their understanding and improve their cognitive outcomes about certain topics in Chemistry included in the app. The students may also gain insights from using Chem Lab such as in effective self-regulated learning and fostering a quality learning experience being guided by the teachers.
2. Teachers may explore the findings of this study to gain further insights into integrating digital tools such as Chem Lab into teaching practices. Understanding the effects of these types of tools may enrich the delivery of science curriculum, promoting interactive and engaging activities that hone diverse skills and intelligence among students.
3. School heads may determine specific learning competencies by using the findings of the study. This insight may help schools adapt and incorporate digital tools such as Chem Lab mobile application into science education, potentially enhancing its utilization across various subjects.

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