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Integrating Android-Based Applications in Teaching Chemistry for Improved Experiential Learning

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Abstract

With the unfavorable learning environment blamed for students' subpar Science performance, new approaches to education were developed including the advancing technology and its application in the educational process. This study intended to determine the effectiveness of integrating Android-based applications in teaching chemistry for improved experiential learning of students. The study used a descriptive-experimental design using one hundred twenty (120) junior high school students enrolled in one public high school in Alaminos, Laguna, for the school year 2021-2022. The study revealed a significant difference in the pre-test and post-test scores of the students based on experiential learning constructs. Likewise, a significant relationship was found among variables suggesting that student perceived the integration of Android-based application as effective tool in teaching chemistry. The study's findings indicate that the level of experiential learning of most students in Science improved after integrating the Android-based applications. Results suggest that teachers may consider using Android-based applications in teaching Science that includes learning activities suited to the topic and can give students the opportunities to improve the level of their experiential learning. Lastly, a study using low and high-performing students may be conducted to further assess the strength of the Android Applications as to applicability and effectiveness.

Keywords: *Android-based applications, experiential learning, junior high school*

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1. Introduction

Students are increasingly required to use their mobile devices (smartphones) for everything, hold the world in their hands, and access any information from any location. This eliminates the need to search for the data in the library. Consequently, a smartphone can be used for various purposes as mobile applications facilitate the accessibility of information. Each mobile application has a distinctive service-providing feature. It has resulted to using e-learning as an alternative approach to education and learning (Jin & Junio-Sabio, 2018). This method reflects the attributes of non-contact, representing the least risky strategy for avoiding the spread of COVID-19 (Madimabe & Omodan, 2021). In the never-ending education process in the 21st century, the emphasis has shifted to e-learning.

Things like social media contain elements of the web that communicate information exchange and are favorites among school-aged adolescents regarding how they interact and share information from every corner of the globe (Madimabe & Omodan, 2021). With smartphones and various feature-oriented applications, students can learn independently and take time to comprehend concepts, as everything is accessible with a single click. Specialists in educational research develop new methods for disseminating knowledge to the general public and then share the benefits of best practices with teachers and the broader community (Aliazas & Chua, 2021). This includes, among other things, introducing students to activities that will help them learn in innovative and creative ways. Students would be compelled to prioritize subject-specific instruction, urgently required (Panoy et al., 2022).

According to Sevari (2012), smartphones are inexpensive, and many users can own at least one smartphone per user. Researchers also claim that people enjoy using their smartphones since they are simple to use and can be carried around in their pockets at all times. According to Mansour (2015), smartphones are becoming increasingly significant in today's society because of their ability to connect. It is not only used for making phone calls and sending text messages, but it may also assist us in connecting with other forms of connectivity, such as social networking sites like Facebook, Twitter, Instagram and E-mail, among others (Villon & Del Rosario, 2022).

Alson (2016) indicates that smartphones connect users to social media, while some use them as tool for learning; they use them as a calculator, write notes, search for Google and so on. Some use their smartphones as a tool for social networking. Users can download an application

to get the latest song or movie, which is convenient for those who lead a busy life. It can also provide the latest in entertainment (Callo & Baguna, 2017). These emphasize a change in the reading habits of the general public. In direct proportion to the average use and number of mobile device users, the increase in knowledge generated due to scientific and technological advances is directly proportional. By the year 2015, students at 88 percent between the ages of 13 and 17 have used smartphones; therefore, school administration should reconsider their smartphone ban policy so that smartphones are appropriate in today's learning environments (Clayton and Murphy, 2016).

The use of a mobile application like High School Chemistry Class, an application with tons of different science experiments with instructions students can do right at home easily. Likewise, Periodic Table-Game android applications can help students learn the periodic table and can allow them to memorize the symbols and other properties of chemical elements quickly. The Android Application used in the study, namely; Chemi Lab-Interactive Chemistry Learning (Davenport et al., 2012), is a 3D interactive application for learning fundamental Chemistry concepts. Elements & Periodic Table Quiz (Setu & Basar, 2019) this application, students can learn the names and symbols of all 118 chemical elements of the Periodic Table (Astiningsih & Partana, 2020) with this application. IN MEL VR Science Simulations (Sharpe et al., 2008), students can explore chemical elements, atoms and molecules in Virtual Reality (Naik, 2017).

These applications helped improve students' experiential learning by providing activities and opportunities to learn independently. Since students during the Covid-19 pandemic were forced to continue their studies at home without the guidance of their teachers, it was hard for them to understand their lessons fully (Panergayo & Aliazas, 2021). Hence, these applications were introduced to the Grade 8 students of Alaminos Integrated National High School that were used as instructional material in learning Science. These served as their mentors and facilitators in learning. Students' experiential learning improved by conducting experiments provided by the Applications, playing games, exploring chemical elements in Virtual Reality and many more.

2. Literature Review

2.1. Android-based Application Integration to Teaching

According to Kacetl and Klímová (2019), mobile learning is becoming a significant component of education because it offers excellent opportunities for learning a foreign language.

In a study by Yang et al. (2013), a quasi-experiment was conducted in an elementary school with 92 sixth graders to evaluate the efficacy of the suggested approach. The experimental findings demonstrate that, in terms of learning outcomes, the concept map-oriented ubiquitous learning strategy is much more beneficial to students when they read printed books than traditional book reading and the conventional universal learning approach. Likewise, the study of Panergayo and Aliazas (2021) suggested that there is a strong acceptance among students that technology adoption is necessary during the time of health crisis.

A study by Jin and Junio-Sabio (2018) looked into the potential use of mobile devices in a few Manila, Philippines, public senior high schools. In this study, 152 students from various schools participated as respondents. It was discovered that most participants used mobile devices and had internet connections when engaging in learning activities outside of traditional classroom settings. As technology adoption has been increasing among students, flexible learning modality was also represented by these changes in the learning environment (Callo & Yazon, 2020).

In another study, Ramos and Comendador (2019) created the mobile app ARTitser as a learning aid for Biological Science. The iOS above application, which uses augmented reality (AR) technology, can assist teachers in facilitating the delivery of regular lectures by providing a realistic portrayal of objects for a better study experience. It can also help teachers monitor students' performance using an interactive and ever-changing AR lesson. Similarly, an application of the binary ionic bonding subject in chemistry is developed in a research study by Bactong et al. (2021). The respondents concurred that the application had improved their focus on learning in terms of their intrinsic drive.

The qualities and opportunities of using smartphones for students are explained in the study of Mulyani et al. (2019), particularly concerning a smartphone offering experiential learning activities. The study aims to identify the benefits, difficulties, and solutions of using mobile phone applications in teaching and learning. The study concludes that students are enthusiastic about using smartphones for social networking, instant messaging, playing online games, and other enjoyable activities. Smartphones have benefits, but if not used correctly, they can also be a distraction and a problem (Aliazas et al., 2021). Students may learn new information in experiential learning courses by participating in learning that takes place in real-life situations. Students can learn more about their questions and how to answer them by using

mobile devices to make observations outside of the classroom (Petrovic et al., 2014). Farrah and Abu-Dawood (2018) suggest that students could comprehend and learn more effectively when using mobile applications.

2.2. Experiential Learning

This research is based on the Experiential Learning Cycle, a popular learning framework popularized by David Kolb (2018). The experiential learning cycle consists of the four stages of learning—experience, reflection, thought, and action—which are repeated with each new interaction and experience. Experience-based learning is a cycle that begins with a new experience, continues through contemplation, analysis, and the development of new perspectives, and culminates in a decision to take action by actively experimenting with or testing one's newfound knowledge. Taking part in this cycle is so commonplace that it often goes unnoticed that it is a form of informal education. It's a constant and ongoing part of our lives, and it happens with surprisingly little effort on our part. People tend to favor certain approaches when using this research (Syaifullah et al., 2021).

The cognitive domain taxonomy developed by Bloom (Huitt, 2011) is another framework used to direct this investigation. K-12 educators, as well as their higher education counterparts and researchers, have relied on this framework for decades. There were six main parts to it: awareness, understanding, competence, critical thinking, and assessment. Following "knowledge," the categories presented were "skills and abilities," with the caveat that knowledge was required to perform these abilities (Wilzon, 2016).

According to experiential learning theory, knowledge and competence can be improved through repeated cycles of experience and reflection. With Bloom's taxonomy, progress is track through a progression of ever-more-in-depth and intricate stages of education. The two models are conceptually combined to demonstrate how students can progress to greater depths of knowledge through repeated exposure to practical situations (McCarthy, 2016).

The design of the android applications used in this study provides opportunities for the student to engage in some experiential learning activities that can help them develop cognitive learning, such as knowledge and comprehension analysis, and gives priority to evidence for lifelong learning (Carada et al., 2022). Using android applications, the study findings assist

students in developing pleasant and productive study habits and thus, improve the learning process.

3. Methodology

A descriptive-experimental research design was used to determine the effectiveness of integrating Android-based applications in teaching Science 8 students in the school year 2021-2022. This is a process of collecting and analyzing numerical data. According to Creswell (2016), quantitative research contains and analyzes numerical data. It can also generalize results to a larger population, find averages and patterns, and test causal relationships and predictions.

The Android Applications used in the study were Chemi Lab-Interactive Chemistry Learning (Davenport et al., 2012), High School Chemistry Class (Astiningsih & Partana, 2020), Periodic Table-Game (Setu & Basar, 2019), MEL VR Science Simulations (Sharpe et al., 2008) and Elements and Periodic Table Quiz (Naik, 2017). These applications were used as the student's learning material in Science. These included activities where students can learn and improve their experiential learning through various activities and experiments.

One hundred twenty (120) 8^{th} grade students at Alaminos Integrated National High School who were enrolled during the school year 2021-2022 make up the heterogeneous samples of the study. A randomly generated technique was used to select 120 samples from among the high and low-performing groups of students. The sample size was calculated using Andrew Fisher's formula (Jung, 2014) with a confidence level of 95% and a confidence interval of 0.5%.

Students' perceptions of the features of the Android-based application in teaching science were assessed using a questionnaire created by the researcher. Likewise, their experiential learning was measured regarding their cognitive categories, such as knowledge, comprehension and skills. Three (3) sets of instruments were used in the study to gather the data necessary to answer the research questions.

Basic information about the respondents was gathered through a questionnaire created by the researcher. The questionnaire used to determine the factors related to the effectiveness of integrating an Android-based application in teaching Science includes 20-item statements. The instrument used to determine the students' experiential learning level comprised a 20-item self-made pre-test and post-test. The test was based on its objectives and included items that can

assess both learnings of the concepts and cognitive categories in Science using Android Applications. Such tests were scrutinized and validated by a panel of experts from a national high school in Laguna. Some of the comments incorporated were changing the pre-test and post-test questions from essay to multiple choice, attaching android legal notice on the use of android applications and changing some Android-based applications that can cater to students more experiential learning. Lesson exemplars (LE), curriculum guide, android applications, pre-test and post-test were used to determine the instructional material's effectiveness. These instruments were checked and validated by a panel of experts composed of two head teachers, one master teacher and two Teacher III from a national high school in Laguna to ensure the effectiveness of using android applications in improving the experiential learning of grade 8 students.

The following statistical tools were used to address the issue identified by the research. The mean and standard deviation were used to determine students' perception of Android Applications' features and their level of experiential learning before and after using Android Applications. A t-test was used to determine if there was a statistically significant difference in students' learning experiential learning before and after using the android applications and determine the relationship between students' learning experience in Science and the features of Android Applications.

4. Findings and Discussion

Table 1

Test of Difference in the Experiential Learning of Students Before and After Using the Android Applications as to Knowledge, Comprehension and Analysis.

	Pre-test		Post-Test		Mean Difference	t	df	Sig. (2-tailed)
	Mean	SD	Mean	SD				
Knowledge	5.49	2.520	8.53	1.869	3.042	12.877	119	.000
Comprehension	3.17	1.568	4.04	1.246	.875	4.690	119	.000
Analysis	1.50	1.174	2.79	1.425	1.292	8.038	119	.000
Overall	10.17	4.057	15.53	2.620	5.167	13.471	119	.000

Legend: If sig ≤ .05 (significant); if sig > .05 (not significant)

To test the effectiveness of Android-based applications as a learning material integrated with teaching Science and the improvement of the student's experiential learning, the Android-based applications, namely; Chemi Lab-Interactive Chemistry Learning (Davenport et al., 2012), High School Chemistry Class (Astiningsih & Partana, 2020), Periodic Table-Game (Setu &

Basar, 2019), MEL VR Science Simulations (Sharpe et al., 2008) and Elements & Periodic Table Quiz (Naik, 2017) were used as a learning material of students in learning Science.

Students were given a pre-test before using the said Applications and a post-test after using the Android Applications. The results indicate that the experiential learning of students before and after using the android applications as to Knowledge, Comprehension and Analysis is significantly different. It can be gleaned from the table that knowledge has a t-value of 12.877 (p=.000), comprehension has 4.690 (p=.000), and analysis has 8.038 (p=.000) with an overall t-value of 13.471 (p=.000).

Experience-based learning, in which students learn through activities like field trips and research, can benefit significantly from integrating Android-based applications as supplementary course materials. Knowledge, comprehension, and analysis in junior high school students can all benefit from this kind of hands-on experience (Ortiz & Aliazas, 2021). The fact that students' mean gain scores went up suggests that using Android-based apps as a learning resource is productive and successful.

Android applications provide a fun way for students to engage in educational activities on their mobile devices. Mobile applications can facilitate experiential learning by opening up new channels for it (Panoy et al., 2022). Students can enhance their experiential learning through the Android-based applications' provided activities and experiments by applying what they've learned in real-world contexts. According to Garillos (2012), students' test scores improved dramatically between the pre-test and post-test when teachers used instructional materials. Furthermore, Voshaar et al. (2022) research on the impact of mobile app use on learning success in accounting education shows that dedicated app users outperform casual app users on final exams.

Table 2

Test of Correlation Between the Experiential Learning of Students in Science and the Level of Effectiveness of Android Applications in Teaching

	Experiential Learning		
	Knowledge	Comprehension	Analysis
User-friendliness	.546**	.472**	.533**
Effectiveness	.444**	.322**	.263**
Usability	.629**	.612**	.552**
Satisfaction	.604**	.523**	.653**

***Correlation is significant at the 0.01 level (2-tailed).*

The table presents the significant relationship between the experiential learning of students in Science and the level of effectiveness of integrating Android-based applications in teaching chemistry. The result shows a significant relationship between all variables, knowledge, comprehension and analysis as constructs of experiential learning and user-friendliness, effectiveness, usability and satisfaction for the level of significance at the 0.01 level. The data indicate that the correlation between all variables is significant. This implies that the features of Android-based applications can improve the respondents' experiential learning level regarding these constructs. Android-based apps were used as a form of educational content that aided students in grasping and retaining the material. The features of these apps improve their experiential learning by giving them challenging tasks related to the material being taught. Learners will benefit from a richer educational experience when android applications are incorporated into the classroom.

Researchers and practitioners should remember that mobile learning helps positively impact students' academic achievement and performance; it can also increase their motivation to learn. In a study by Demir and Akpinar (2018), mobile learning can help students' academic achievement. Furthermore, the students consider mobile learning to keep them motivated. In addition, a study by Petrovic et al. (2014) shows that learning takes place in real-life situations. Students build and strengthen new abilities through already existing knowledge and gathering further information through observation.

5. Conclusion

This study finds a significant difference in students' learning experience before and after using android applications in knowledge, comprehension and evaluation. There is also a significant relationship between the experiential learning of science students and the features of Android Applications, thus, rejecting both the postulated hypothesis for the study. Since the study revealed substantial evidence of the effectiveness of android application in teaching and learning, specifically in the experiential knowledge of students, teachers may consider using Android Applications in teaching Science that includes learning activities suited to the topic and can give students the opportunities to improve the level of their experiential learning. Likewise, the school and school administration may encourage teachers to use an android application as instructional material to enhance the students' experiential learning. Furthermore, this study's

replication using other variables that are not part of the study may be conducted to assess further the strength of the Android applications as to applicability and effectiveness.

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