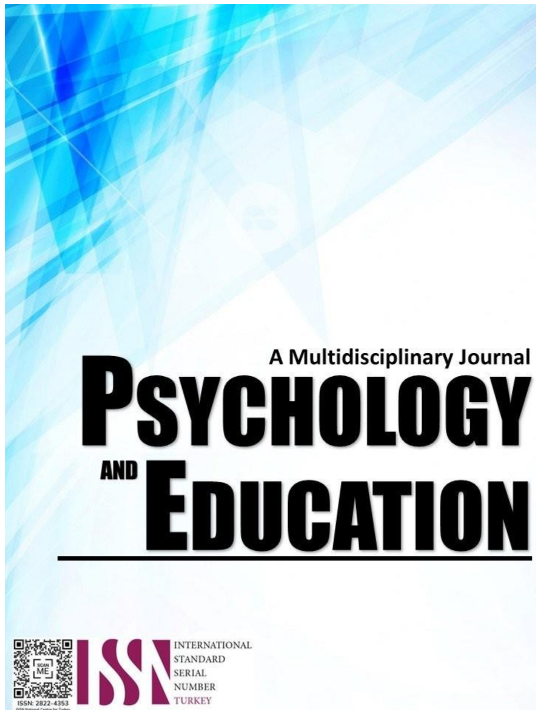
iPAD-INTEGRATED INSTRUCTION AND SENIOR HIGH SCHOOL LEARNERS' SCIENCE PROCESS SKILLS AND ACHIEVEMENT IN CHEMISTRY



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Research Article

iPAD-Integrated Instruction and Senior High School Learners' Science Process Skills and Achievement in Chemistry

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Abstract

This quasi-experimental research aimed at ascertaining the effects of the use of iPad as a teaching approach on the Science Process Skills and Science Achievement of Grade 11 learners. Seventy Grade 11 learners coming from two intact classes with 35 learners in each class of Ateneo de Iloilo composed the two treatment groups, the traditional and iPad-integrated classes. The comparability of the two groups was tested in terms of their pretest scores in Science Process Skills and Science Achievement tests. This research utilized the researcher-made tests in Science Achievement and Science Process Skills. The statistical tools employed were mean, mean gain, and standard deviation for descriptive statistics; t-test for independent samples and Pearson's product moment correlation for inferential statistics. The study revealed that the pre intervention levels of performance of both the traditional and iPad-integrated classes were "Average" in Science Process Skills and "Average" in terms of Science Achievement. The posttest scores in Science Process Skills revealed that the learners exposed to iPad-integrated instruction had "Average" level and those who were exposed to the traditional instruction had "Very High" levels of Science Process Skills. On the other hand, their posttest scores in Science Achievement were "High" and "Average" for the iPad-integrated and traditional classes, respectively. No significant differences were observed in the pretest scores of the learners in Science Process Skills and Science Achievement in both groups. Meanwhile, there were significant differences in the post-intervention Science Process Skills and Science Achievement of the learners in the traditional and iPad-integrated classes. Moreover, significant difference was observed in the mean gains scores in Science Process Skills and Science Achievement of the two groups. Significant relationships were likewise observed between the posttest scores in Science Process Skills and Science Achievement. However, Science Process Skills and Science Achievement had significant relationship but had weak correlation. It is recommended that in teaching Chemistry, iPad-integrated instruction should be blended with traditional instruction as both were found to be complementary strategies that result in enhanced Science Process Skills and Achievement of the learners.

Keywords: *technology integration, science education, science process skills, senior high school*

Introduction

The teaching landscape is rapidly changing; the technological rise of the 21st century and widespread integration of those technologies into the present society, combined with access to the internet, have integrally changed teaching in just few years.

In the era of information technology, iPads have become an effective technology in science teaching. iPads have been integrated to teaching methodologies and most of the recent research revealed that iPads can enhance student learning. iPad-based learning aims at raising students' awareness of learning strategies providing learners with systematic practice, reinforcement, and self-monitoring (Retrieved from: http://www.iosjournals.org/iosr jrme/papers/Vol-5%20Issue1/version2/J05125865.pdf).

Children and the following generations are already growing and will continue to grow up in a world that is a stark reminder of how rapidly the human civilization has changed, a society and a world where smartphones and tablets are widespread, affordable, and replacing most computers and laptops (Giarla, 2016).

Many researches have been done to show the importance of how certain innovations incorporated inside the classroom can affect students' learning. In todays' generation, it is important to incorporate certain innovations and that include the use of technology.

Presently, schools are coping with the change of learning styles of the so-called millennial learners and have incorporated the use of iPads in the teaching and learning process. Different applications are used to aid the teaching and learning process. This study tries to view modern e-learning devices and their applications to teaching Senior High School students. The objectives can be depicted as the following: (1) to apply new and alternative models apart from traditional ones in teaching through taking advantage of the iPads, (2) to identify the differences in the achievement and science process skills of Senior High School students who use iPads in studying and among those who are studying in the traditional manner, (3) to raise awareness of Senor High School teachers of other majors to use the iPad in the educational process, and (4) to emphasize the importance of using the iPad in providing an interactive learning environment which takes into account individual differences among learners.

The researcher's school envisions itself to be the leading Catholic basic education institution in Western Visayas pioneering in the innovative and integral formation of young leaders who are ready to engage in nation-building (Strategic Plan, 2016). The innovative formation of 21st-century young leaders necessarily involves equipping them with skills that will allow them to use information and communications technology (ICT) as a tool to communicate, collaborate, think critically, and create innovative solutions to real-world problem. The school aims to provide and excel in this area of formation and even to be at the forefront of ICT integration in its curriculum and instruction.

With this goal in mind, the school began mobilizing its resources as early as School year 2015-2016 as an initial step towards ICT integration. The whole ICT integration program involves setting up infrastructures as well as lead team that will spearhead and champion the thrust of the school. The following objectives are therefore set to form a technology integration team that will help initiate ICT integration in curriculum and instruction, to provide ICT integration and professional development for teachers, to build inventory tools such as mobile computers that are accessible to teachers and learners, to allocate resources to improve internet connectivity, and to build a culture of technological literacy among stakeholders.

As a teacher, the researcher believes that teaching with technology can deepen student learning by supporting instructional objectives. However, it can be challenging to select the best tools while not losing sight of the goals for student learning. Integrating these tools can itself be a challenge but an eye-opening experience. Despite all investments on ICT, infrastructure, and equipment in this school, ICT adoption and integration in teaching and learning specifically in the use of iPad have been limited.

Aligned with the goals of the school, it is also a high time to integrate lessons using the iPad as part of the investment of the school. Classroom technology can require huge instructional and mindset shifts that can be overwhelming to many teachers (Kim, 2016). Through this study, the researcher believes that others can be encouraged to design lessons which integrate the use of iPad. This study may also help widen the perspectives and venues of opportunities to place learning in the hands of the students to construct their own knowledge anchored on prior knowledge to improve their ways of acquiring knowledge.

This investigation is anchored on the theory of constructivism by Piaget (1973). Constructivism is a theory of knowledge that argues that humans generate knowledge and meaning from interactions between their experiences and their ideas. Constructivism frames learning less as the product of passive transmission than a process of active construction whereby the learners construct their own knowledge based upon prior knowledge (Duffy, et al., 1993; Piaget, 1971; Steffe & Gale, 1995). Constructivist learning requires learners to demonstrate their skills by constructing their own knowledge when solving real-world problems. The constructivist model calls for learner-centered instruction because learners are assumed to learn better when they are forced to explore and discover things themselves. Student-centeredness is another pedagogical approach whereby students are given more control over their own learning (Chandra-Handa, 2001; Haughey, 2002, Smeets & Mooji, 2001). Student control facilitates student-centeredness. Technology should be employed in ways that pedagogical strategies that are learner-centered develop in classrooms (Haughey, 2002). Teachers are responsible for this development. In this technological revolution and information age, using technology in teaching becomes a "fact of life."

Related to social constructivism, situated learning is a recent, more defined learning theory. Lave and Wenger (1980) worked together in the late 1980s and the early 1990s to study and eventually publish their first book defining and, arguably, justifying situated learning. "Lave's ethnographic studies of learning and everyday activity reveal how different schooling is from the activities and culture that give meaning and purpose to what students learn elsewhere" (Brown, Collins, & Duguid, 1989, p. 35). The premise and pedagogical foundation of this theory are that learning is more effective in shared social situations, termed communities of practice. Wenger (1980) went further to define the following three aspects of communities of practice, the domain, the community, and the practice. The domain is the specified shared pursuit and is the shared group attribute. The community is the environment in which interaction takes place and relationships are developed. The practice is defined as the "shared repertoire of resources: experiences, stories, tools, [and] ways of addressing recurring problems" (Smith, 2009). The concept of communities of practice is heavily weighted in the pedagogies of collaboration and learning contexts.

The context in which learning takes place is essential to determining the authenticity of the task. According to Neo (2007), "context is an integral part of the learners' concept of meaning, and their cognitive experiences must be situated in authentic experiences in order for them to pursue solutions to their tasks". If one were to reflect on the context learning has taken place in education in past years, most would visualize a room with desks lined in a row, an instructor in the front of the room and students whose participation usually took place in response to an inquiry made by the instructor.

Sadly, many would say that is what they see in a school room today which is not reflective of the authentic societal context people live and socialize in and vehemently conflicts with constructivist pedagogies. "A primary guiding principle… recommends involvement of students in authentic activities that are situated in strong, life-like context, that encourage construction of adaptive knowledge, and that make those students good thinkers and problem solvers today and tomorrow" (Taylor, Casto, & Walls, 2004, p. 123). Industry, government, business down to the core of society, the family, communicate and collaborate using tools of technology.

If learning is to take place in an authentic context, technology, specifically the Internet, must be utilized. This authentic context has "been applied to the learning digital technology and cultures in spaces such as social networking sites as young people immerse themselves in the language, skills, and discourses of communities online" (Willet, 2007, p. 170). If one was to peruse the Internet, countless online groups with specific shared interests exist and within these groups people learn, share, and grow together. An essential constructivist pedagogical attribute shared within these authentic communities of practice is collaboration.

In some classrooms, collaboration holds to constructivist pedagogy as students work together on authentic tasks and as the teacher provides scaffolding, feedback, and guidance as a facilitator of learning.

"The collaborative activities with others, promoted by this [type of] learning environment, allow [students] to develop multiple perspectives, where some type of 'shared reality' is produced" (Neo, 2007, p. 151). Collaboration guides learners toward "the domain" necessary in communities of practice. Integrating the powerful and common tool of technology, collaboration extends beyond the four walls of a classroom to communities around the world. In a classroom, students can utilize technology in a collaborative effort as they research information on the web or create a product using software guided by a common goal. Outside of the classroom, learners can use online discussion boards, social networking sites, online chat, wikis, and numerous other technology-based tools to collaborate on a common endeavor.

Some concerns have been voiced with the use of technology in collaboration, including "power relations which are enacted in these environments, how relations of inequity are being rehearsed rather than challenged, and what happens when a member of a community … wants to challenge the practices of the community" (Willett, 2007, p. 170). More than ever, the role of the instructor as a facilitator is the key to effective collaboration in online communities of practice. A study by Tu, Shih, & Tsai (2008) found "learners with more constructivist-oriented epistemological beliefs tended to express more preferences to engage in metacognitive thinking in web environments" (p.1143). As collaborative learning using technology becomes increasingly common, more concerns might arise and will need to be studied and addressed. Although situated learning established in authentic contexts using collaboration is somewhat attainable without the use of technology as a tool, achieving success in constructivist pedagogies has greater possibilities and truer opportunities when technology becomes a part of situated learning (Ford & Lott, 2009).

Situated Cognition is another emerging theory that supports the use of technology and help to create more authentic learning environments. It is a learning theory which supports the idea that learning occurs only when situated within a specific context. It believes that learning takes place in a learning community or community of practice, when the learners take an active role in the learning community. It involves a practice of interaction between the learners within a community, the tools available within the specific situation and the physical world. It is within this active participation, this interaction (whether with tools, artifacts, or other people), where knowledge is located. Therefore, knowing evolves as the learners participate and interact within the new situation. Cognition is linked to the action the learners in the community take, whether it is physical in nature or a reflective process within the learners themselves (Myers & Wilson, 2000). Myers & Wilson put it this way: "the development of knowledge and competence, like the development of language, involves continued knowledge-using activity in authentic situations" (Myers & Wilson, 2000, p. 71). Situated cognition also takes into account the culture of the community at large and "treats culture as a powerful mediator of learning and practices, both for students and teachers (Myers & Wilson, 2000, p. 83)". Basically, a program based on this theory will not be successful if the larger communities, outside the learning environment, culture is not considered, as it can define what may be possible within the learning environment (Myers and Wilson, 2000). The main points to remember about situated cognition for the purpose of this paper are that "knowing, learning, and cognition are social constructions, expressed in actions of people interacting within communities" (Myers & Wilson, 2000, p. 59). Therefore, without action, there is no learning.

So, what is the role of technology within this emerging theory of learning? As stated above, action needs to take place in order for cognition to occur. This action must take place within a community of practice or learning community. This action often involves interaction between tools or artifacts that are situated in the community (Myers & Wilson, 2000). These tools and/or artifacts are invaluable parts of the learning system. Without these parts, the interaction they produce, assist, or motivate, may not occur. Therefore, technology in this learning theory is a piece of the learning environment that helps to bring to that cognition. Myers & Wilson (2000) state: "These tools and constructed environments constitute the mediums, forms, or worlds through which cognition takes place. Problem solving involves reasoning about purposes in relationship to the resources and tools which a situation affords".

It is quite clear that the learners who are placed into this type of learning environment would be using their knowledge and skills by thinking critically, applying knowledge to new situations, analyzing information, comprehending new ideas, communicating, collaborating, solving problems, making decisions" (Honey, et al, 2003, p. 9). This learning theory supports the very skills needed by the 21st century.

Research Questions

This study aimed at ascertaining the effects of the use of iPad as a teaching approach to enhance Science Process Skills and improve the Science Achievement of Grade 11 learners. Specifically, the study sought answers to the following questions:

1. What are the levels of Science Process Skills of the Senior High School learners before and after exposure to Traditional and iPad-integrated instruction?
2. What are the levels of Science Achievement of the Senior High School learners before and after exposure to Traditional and iPad-integrated instruction?
3. Are there significant differences in the Science Process Skills and Science Achievement of Senior High School learners before exposure to Traditional and iPad-integrated instruction?
4. Are there significant differences in the Science Process Skills and Science Achievement of Senior High School learners after exposure to Traditional and iPad-integrated instruction?

5. Are there significant differences in the mean gain scores in the Science Process Skills and Science Achievement of Senior High School learners exposed to traditional and iPad-integrated instruction?
6. Is there a significant relationship between Science Process Skills and Science Achievement of Senior High School learners?

Methodology

Research Design

This study utilized the quasi-experimental research design. According to Fraenkel & Wallen (2012), quasi-experimental design is applied when intact groups are used as participants. The design does not include the use of random assignment. Moreover, researchers who employ this design rely instead on other techniques to control or reduce the threat to internal validity.

Respondents

The subjects of this study were the seventy (70) Grade 11 Senior High School learners from two intact classes of a private sectarian school in the Division of Iloilo City, Philippines, who were taking General Chemistry 1 particularly on measurements and experimental techniques, atoms, molecules, and ions as content coverage for the first semester of schoolyear 2017-2018. To ensure the comparability of the two groups, the researcher match-paired the subjects based on their total pretest scores. A total of 70 match-paired learners were utilized as subjects in the study, with 35 subjects per group.

One group was exposed to traditional instruction and the other to iPad-integrated instruction. The toss-coin technique was used to determine the experimental and the control groups. The experimental group was exposed to iPad-integrated instruction (iPII) while the control group was exposed to traditional instruction (TI).

Instrument

The data needed in this study were gathered using two (2) researcher-made instruments, namely: the Test for Science Achievement (TSA) and Science Process Skills Test (SPST).

Test for Science Achievement (TSA). This instrument was a 50-item multiple choice test focused on the following Chemistry topics for Grade 11: measurements and experimental techniques; atoms; molecules, and ions which were based on the K to 12 curriculum guide and competencies provided by the Department of Education. The same instrument underwent expert validation and pilot-testing.

Initially, TSA was composed of 70 items. The 70-item TSA was pilot tested and the result was item analyzed and the 50-item TSA with alpha=0.843 was used in both pre-test and posttest.

Science Process Skills Test (SPST). This instrument was a 50-item multiple choice test on basic and integrated science process skills on the K to 12 curriculum guide and competencies provided by the Department of Education. The same instrument underwent expert validation and pilot-testing.

Initially, SPST was composed of 70 items. The 70-item SPST was pilot tested and the result was item analysed and the 50-item SPST with alpha=0.859 was used as pre and posttest.

Procedure

The data gathering procedure was conducted in three stages: pre-experimental stage, experimental stage, and post- experimental stage.

Pre-experimental stage. A permit to study was secured by the researcher beforehand and the letter was handed to the principal for the permission to use the Grade 11 Senior High School in the STEM strand learners of the research locale as the subjects in the study. After determining the subjects, the two sections were assigned to the experimental and control group using the toss coin technique taking into account the homogenization of both groups in order to avoid biases and pre-established disparity between two groups. Before the onset of intervention, separate matrices of activities and lesson plans for both traditional instruction and iPad-integrated instruction were prepared by the researcher and were distributed to experts for validation. After the validation, all comments and suggestions were incorporated, the Science Process Skills Test (SPST) and Test for Science Achievement (TSA) and were pilot tested to selected Grade 11 learners in the STEM strand in the same school. The data were collected, tabulated, and subjected to appropriate statistical analysis.

Experimental Stage. Prior to the start of the intervention, the purpose of the study and the conduct of the intervention were explained to the learners. The two groups were given the pre-tests, a 50-item Science Process Skills Test (SPST) and another 50-item multiple choice Test for Science Achievement (TSA). The two groups had the same lessons and references. The topics that were discussed in the entire activity were: measurements and experimental techniques, atoms, molecules, and ions. The learners in the two sections who became the subjects of the study were determined by means of match pairing based on their pretest scores. The experimental group was exposed to instructional method using iPad and the control group was exposed to traditional method.

The researcher provided a series of activities for engagement, exploration, and experimentation to develop learners' achievement and science process skills.

During the exploration stage, the experimental group was instructed by the teacher to individually explore different iPad applications and form groups for cooperative learning activities. The experimental group was exposed to instructional method using iPad as instructional material during their science activity in order to understand the concepts in the following topics: measurements and experimental techniques, atoms, molecules, and ions.

On the other hand, the control group was exposed to traditional instruction wherein the teacher facilitated and guided learners' needs in conducting the science activities. The learners were exposed to learning activities which did not use the iPad. Outputs of these activities were collected but were not used as research data as they were used for grading purposes only.

In the conduct of the study, the members of the research panel were invited to observe classes to ensure that the given intervention to the subjects was properly implemented.

Post-experimental Stage. At the end of the six-week intervention, parallel instruments as the pretests were administered as posttests. The results of the post-test were analyzed using SPSS to determine any significant difference before and after exposure to the different instructional methods.

Data Analysis

Descriptive Data Analysis. The statistical tool employed to analyze descriptive data were mean and standard deviation to determine the levels of science achievement and science process skills before and after exposure to traditional instruction iPad-integrated instruction in science teaching.

Table 1. *Scale on Measuring the Level of Science Process Skills and Science Achievement*

Mean Range	*Descriptive Rating*	*Description*
40.00-50.00	Very high	The learners at this level exceed the core requirements in terms of knowledge and understanding science concepts and science process skills
30.00-39.99	High	The leaners at this level have developed the fundamental knowledge, and understanding science concepts and science process skills
20.00-29.99	Average	The learners at this level have developed the fundamental knowledge, understanding science concepts and science process skills with little guidance from the teacher and/or with some assistance from peers.
10.00-19.99	Low	The learners' at this level possessed the minimum knowledge, and understanding science concepts and science process skills
1.00-9.99	Very low	The learners at this level struggled with their knowledge, understanding science concepts and science process skills

Inferential Data Analysis. The statistical tools utilized to analyze inferential data are t-test for independent samples to compare means of traditional instruction and iPad-integrated instruction in science teaching , and Pearson's Product Moment Correlation (Pearson's r) to determine the significance of the relationship between Science Process Skills and Science Achievement after exposing the learners to traditional instruction and iPad-integrated instruction in science teaching.

All statistical computations were computed using the Statistical Package for the Social Sciences (SPSS) software. The statistical significance was set at 0.05 alpha level of significance.

Results and Discussion

This study aimed at ascertaining the effects of the use of iPad as teaching approach on the Science Achievement and Science Process Skills Grade 11 learners.

Chapter Four presents the findings of the investigation. The data from this quasi-experimental study were obtained through the use of researcher-made instruments. Analysis of the data are presented in two parts: (1) Descriptive Data Analysis, and (2) Inferential Analysis.

Part One, Descriptive Data Analysis, describes the level of science process skills and science achievement of Grade 11 learners before and after exposure to two teaching methods.

Part Two, Inferential Data Analysis, presents analysis conducted to test the significance of the difference in terms of science process skills and science achievement of the subjects in the experimental and control groups. Moreover, the test for significance, strength, and direction of the relationship between Science Process Skills and Science Achievement is presented.

Descriptive Data Analysis

To determine the levels and dispersion of the scores in Science Process Skills (SPS) and Science Achievement (SA) of Grade 11 learners exposed to iPad-integrated instruction and traditional instruction, the researcher used mean and standard deviation were used.

Pretest and Posttest Level of Science Process Skills

Table 2 shows the results of the pretest in Science Process Skills of learners when taught through traditional instruction and iPad-integrated instruction.

Prior to intervention, the group to be exposed to iPad-integrated instruction (M= 28.086, SD= 2.548) and the group to be exposed to traditional instruction (M= 27.371, SD= 2.402) had "Average" level of Science Process Skills. This means that the learners have developed the fundamental knowledge, and understanding science concepts and science process skills with little guidance from the teacher and/or some assistance from peers. The results showed a slight difference in the mean scores of the two groups before the intervention was conducted. Also, the standard deviations of the two groups were considered to be narrow, indicating homogeneity among the learners' responses.

Table 2. *Science Process Skills of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*n*	*SD*	*M*	*Description*
Traditional Instruction	35	2.402	27.371	Average
iPad-integrated Instruction	35	2.548	28.086	Average

Note: 1.00-9.99-Very low; 10.00-19.99-Low; 20.00-29.99-Average; 30.00-39.99- High; 40.00-50.00-Very high

On the other hand, the posttest mean scores in Science Process Skills of the learners exposed to iPad-integrated instruction (M=34.971, SD=2.548) and the learners exposed to traditional instruction (M=40.286, SD= 2.283) were "High" and "Very High", respectively. The results are shown in Table 3.

Table 3. *Science Process Skills of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*n*	*SD*	*M*	*Description*
Traditional Instruction	35	2.283	40.286	Very High
iPad-integrated Instruction	35	2.548	34.971	High

Note: 1.00-9.99-Very low; 10.00-19.99-Low; 20.00-29.99-Average; 30.00-39.99- High; 40.00-50.00-Very high

Therefore, the learners exposed to the traditional instruction gained higher scores than the learners exposed to the iPad-integrated instruction.

The learners were exposed to activities that support the enhancement of their Science Process Skills because of the activities that allowed them to observe and manipulate which led to better scores in the Science Process Skills Test. These findings support the report of the National Research Council (2005) that interacting with the unconstrained environment of the material world in laboratory experiences may help students concretely understand the inherent complexity and ambiguity of natural phenomena. Laboratory experiences may help students learn to address the challenges inherent in directly observing and manipulating the material world, including troubleshooting equipment used to make observations, understanding measurement error, and interpreting and aggregating the resulting data.

In their experiences, learners may learn to use the tools and conventions of Science. They may develop skills in using scientific equipment correctly and safely, making observations, taking measurements, and carrying out well-defined scientific procedures.

Pretest and Posttest Level of Science Achievement

Table 4 shows the pretest scores in Science Achievement of the learners when exposed to the two learning strategies.

From the data gathered, the group to be exposed to iPad-integrated instruction (M= 26.657, SD= 2.722) and the group to be exposed to traditional instruction (M= 25.829, SD= 2.955) were both "Average" in terms of their Science Achievement as revealed in their pretest mean scores. This means that the learners at this level have developed the fundamental knowledge, understanding science concepts and science process skills with little guidance from the teacher and/or with some assistance from peers. The results showed that the Science Achievement mean scores of the two groups were almost identical and their standard deviation of 2.955 and 2.722 showed a narrow dispersion of the scores about the mean that reveals both groups belong to the same level before the intervention.

Table 4. *Science Achievement of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*n*	*SD*	*M*	*Description*
Traditional Instruction	35	2.955	25.829	Average
iPad-integrated Instruction	35	2.722	26.657	Average

Note: 1.00-9.99-Very low; 10.00-19.99-Low; 20.00-29.99-Average; 30.00-39.99- High; 40.00-50.00-Very high

On the other hand, the posttest mean scores in Science Achievement of the learners exposed to iPad-integrated instruction (M= 35.057, SD= 2.419) and learners exposed to traditional instruction (M= 28.971, SD= 2.443) were "High" and "Average", respectively. The group exposed to iPad-integrated instruction had a numerically higher mean score than that of learners exposed to traditional instruction. The results are shown in Table 5.

Table 5. *Science Achievement of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*n*	*SD*	*M*	*Description*
Traditional Instruction	35	2.443	28.971	Average
iPad-integrated Instruction	35	2.419	35.057	High

Note: 1.00-9.99-Very low; 10.00-19.99-Low; 20.00-29.99-Average; 30.00-39.99- High; 40.00-50.00-Very high

Inferential Data Analysis

Inferential statistics were employed to ascertain whether the differences in the data are statistically significant and whether a significant relationship existed between Science Process Skills and Science Achievement.

This section tested the hypotheses that there were no significant differences in the mean scores of the experimental and control groups.

The t-test for independent samples was computer processed and used to compare means of traditional instruction and iPad-integrated instruction in science teaching, and Pearson's Product Moment Correlation (Pearson's r) was employed to determine the significance of relationship between Science Process Skills and Science Achievement after exposure to traditional instruction and iPad-integrated instruction in science teaching.

Difference in Science Process Skills of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction

Table 6 reveals that there was no significant difference in the pretest scores on Science Process Skills of the learners exposed to traditional and iPad-integrated instruction, [t(34)=1.207, p=.232]. The null hypothesis, which states that, there are no significant differences in the Science Process Skills of Senior High School learners before exposure to traditional instruction and iPad-integrated instruction, was accepted.

It is seen that at the start of the intervention, the learners in the two groups possessed comparatively the same level of Science Process Skills.

Table 6. *Difference in Science Process Skills of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	27.371	34	1.207	.232
iPad-integrated Instruction	28.086			

Difference in Science Achievement of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction

Table 7 reveals that there was no significant difference in the in the pretest scores on Science Process Skills between learners exposed to traditional and iPad-integrated instruction, [t(34)=1.220, p=.227]. The null hypothesis, which states that there are no significant differences in the Science Achievement of Senior High School learners before exposure to traditional instruction and iPad-integrated instruction, was accepted.

It is seen at the start of the intervention, that the subjects in the two groups were comparable in terms of their Science Process Skills.

Table 7. *Difference in Science Achievement of Senior High School Learners Before Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	25.829	34	1.220	.227
iPad-integrated Instruction	26.657			

Difference in Science Process Skills of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction

Table 8 reveals that there was a significant difference in the posttest scores on Science Process Skills of learners exposed to traditional and iPad-integrated instruction, [t(34)=9.453, p=.000]. The null hypothesis, which states that there are no significant differences in the Science Process Skills of Senior High School students after exposure to traditional instruction and iPad-integrated instruction, was rejected.

This result can be attributed to the advantages of hands-on investigations which allow students to experience science phenomena directly through experimentation with physical materials. Through these processes, students can gain experience in planning investigations, using appropriate scientific instruments, and collecting and recording and analyzing real world data.

Computer simulations provide students with de-contextualized representations of real-world phenomena (Hofstein & Lunetta, 2004) in which the causal variables must be pre-programmed into the system, preventing students from testing alternative models that were not planned in advance (Chinn & Malhotra, 2002).

During the conduct of different laboratory activities, learners can manipulate, investigate, and share ideas based on their observation.

The results further show that the iPad-integrated instruction was not as effective as traditional instruction in developing the learners' science process skills.

Table 8. *Difference in Science Process Skills of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	40.286	34	9.453**	.000
iPad-integrated Instruction	34.971			

p < 0.05, significant

Difference in Science Achievement of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction

Table 9 reveals that there was a significant difference in the in the posttest scores on Science Achievement between the learners exposed to traditional and iPad-integrated instruction, [t(34)=9.695, p=.000]. The null hypothesis, which states that there are no significant differences in the Science Achievement of Senior High School learners after exposure to traditional instruction and iPad-integrated instruction, was rejected.

This result could be due to the number of unique features that provide for interesting possibilities in teaching and learning (Johnson, 2011). Results can be attributed to the idea that using iPads in the classroom allowed students to independently construct knowledge, be actively engaged, and be provided with a social context for learning.

Most learners in today's generation are much inclined to the use of technology in learning. The iPad has a number of unique features that provide for interesting possibilities in teaching and learning. The mobility provided by the iPad's wireless telephone connection capability allows unprecedented access to the internet wherever students are. This is truly information on demand. As questions arise, students can google for clues and insights to begin their studies.

Post-millennial learners are adept in application like, games, puzzles, and simulations in iPads. Taking that notion one step further, simulations and game-based scenarios enable students to apply what they have learned in a realistic environment and receive instant feedback.

This goes to show that the use of iPads as instructional material is an effective tool in improving Science Achievement of the learners.

Table 9. *Difference in Science Achievement of Senior High School Learners After Exposure to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	28.971	34	9.695**	.000
iPad-integrated Instruction	35.057			

p < 0.05, significant

Difference in the Mean Gain Scores in Science Process Skills of Senior High School Learners Exposed to Traditional Instruction and iPad-integrated Instruction

To determine if significant differences would exist in the mean gain scores of the Science Process Skills of the two groups exposed to the two teaching strategies, the researcher used the t-test for independent samples.

Table 10 reveals a significant difference in the mean gain scores of the two groups [t(34)=8.977, p=.000] in their Science Process Skills. This means that the improvement in the Science Process Skills of the learners exposed to traditional instruction is significantly higher than that of the learners exposed to iPad-integrated instruction.

This result is aligned with the idea presented by the American Chemical Society in their Public Policy Statement (2014) that hands-on activities enhance learning significantly at all levels of science education. These activities are usually the basis for a "laboratory" class or laboratory portion of a class. In hands-on chemistry course, students directly experience handling laboratory chemicals and their properties, chemical reactions, chemical laboratory apparatuses, and laboratory instruments. These activities are essential in learning chemistry.

Computer simulations have been developed that can mimic laboratory procedures and have the potential to be useful supplement to these hands-on activities. However, these simulations, by their very nature, do not involve contact with and manipulation of laboratory chemicals or equipment and thus should not be considered equivalent replacements for hands-on experiences critical to chemistry courses at any level.

Table 10. *Difference in the Mean Gain Score in Science Process Skills of Senior High School Learners Exposed to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	12.914	34	8.977**	.000
iPad-integrated Instruction	6.886			

p < 0.05, significant

Difference in the Mean Gain Scores in Science Achievement of Senior High School Leaners Exposed to Traditional Instruction and iPad-integrated Instruction

As shown in Table 11, significant difference existed when the mean gain scores in the Science Achievement of the two groups [t (34) =6.812, p=.000] were compared. This means that iPad-integrated instruction significantly improved the students' Science Achievement.

Based on the results of the study, it can be inferred that the learners' achievement can further be developed and enhanced with the use of teaching materials that appeal to the students, specifically the iPad-integrated lessons. The presentation of the lessons truly fascinated the students since today's youth prefer interactive media in learning, and they learn by doing.

Haluk (2007) provides research-based evidence that the learners' achievement in chemistry can be improved through the use of computer-assisted teaching materials. There is, therefore, a powerful link between instructional materials and how students will do in the school setting. Having a diverse set of teaching methods gives an opportunity to blend the art and science of teaching.

Table 11. *Difference in the Mean Gain Score in Science Achievement of Senior High School Learners Exposed to Traditional Instruction and iPad-integrated Instruction*

Group	*Mean*	*df*	*t-value*	*Sig. (2-tailed)*
Traditional Instruction	3.143	34	6.812**	.000
iPad-integrated Instruction	8.400			

p < 0.05, significant

Relationship Between Science Achievement and Science Process Skills of Senior High School Learners Exposed to Traditional and iPad-integrated Instructions

To determine the significance, strength, and direction of the relationship between the posttest scores in Science Process Skills and Science Achievement in each group, the researcher used the Pearson's product moment correlation.

Table 12 shows that there was no significant relationship between Science Process Skills and Science Achievement of the learners when exposed to traditional instruction (r=.115, p=.511) and iPad-integrated instruction (r=.169, p=.332).

According to the study conducted by Johnson (2011), traditional courses in which the students attended lecture and then practiced solving problems outside of the classroom resulted in high levels of success with simple problems such as predicting products of reactions but less than 10% success on challenging mechanisms and multi-step synthesis.

This goes to show that the learners' knowledge in science does not always translate to good science process skills. Science achievement may be influenced by how learners do hands-on activities but of weaker correlation.

It can be inferred that, there is no significant relationship between the Science Achievement and Science Process Skills of learners exposed to traditional and iPad-integrated instruction. Positive and weak correlation was observed between the dependent variables, which means that an increase in Science Achievement can increase Science Process Skills to a lesser degree.

Table 12. *Relationship between Science Process Skills and Science Achievement of Senior High School Learners*

Group		*Science Achievement*
Traditional Instruction		
Science Process Skills	Pearson r	.115
	Sig. (2 tailed)	.511
	N	35
iPad Integrated Instruction		
Science Process Skills		
	Pearson r	.169
	Sig. (2-tailed)	.332
	N	35

Conclusions

Based on the findings, the following conclusions were drawn:

The Science Process Skills and Science Achievement of the Grade 11 learners were not yet fully developed. This means that there is still room for improvement in learners' Science Process Skills and Science Achievement if appropriate instructional strategies and materials are used. This can be related to the idea that the Grade 11 learners can have good learning experiences if they are exposed to appropriate strategies and materials wherein they can make sense with their existing knowledge.

The Science Process Skills and Science Achievement of the Grade 11 learners can be enhanced regardless of whether they are taught using traditional or new instructional strategies. Even before the arrival of computers in human history, it seemed natural for many to describe "higher-order thinking skills" or rationality, in terms of abstract reasoning on the model of formal logic or mathematics. This kind of thinking was really hard, potentially very useful and only a few people could do it well.

The learners can learn from both strategies as their prior knowledge can be associated to new learning experiences. Further elaboration of such context could also be exhibited through iPad-integrated instruction which focuses on representations and simulations and traditional instruction using hands-on activities and laboratory activities.

The learners, when exposed to the same level and nature of instruction can accumulate the same level of learning due to the fact that delivered instruction is the same. They were exposed to the same instruction in their Junior High School, having come from the same school.

iPad-integrated instruction is better than the traditional instruction in developing the learners' Science Achievement. However, traditional instruction has better effect than iPad-integrated instruction on learners' Science Process Skills.

iPad-integrated instruction was better in limited aspects of learners' development. The activities and learning environments must be carefully guided and structured so that learners are fully engaged in their learning. In a technology-rich classroom, students do not learn technology. Technology merely provides the tools to be used for authentic learning. It is a means, not an end. With this in mind, technology could then improve some aspects of learning but the incorporation of other strategies can improve other aspects.

Science Process Skills is not always a function of Science Achievement. It does not always mean that high scores in Science Process Skills are a guarantee to high scores in Science Achievement. The weak correlation between the variables does not always relate the two.

In view of the aforementioned findings, conclusions, and implications, the following recommendations are advanced:

Technology can be used in delivering instruction to improve Science Achievement as most learners are considered to be visual learners while in developing Science Process Skills, laboratory activities need to be performed.

iPad-integrated instruction and traditional instruction can be used as complementary strategies in delivering instruction to enhance science achievement and science process skills of learners.

Technology has an effect on the engagement of the learners; therefore, it could also be good that education program supervisors should invest on providing materials and equipment that promote computer-assisted instruction. ICT integration could help improve learners' understanding. Laboratories should also be improved for the hand-on activities of the learners.

Secondary school administrators should also update the necessary learning materials provided to the learners. Exposure to ICT and hands-on activities can lead to better learning, thus, it should be considered as an investment to aid in students' learning and skills and to provide variety to teachers' strategies in teaching.

In developing instructional materials, it is also necessary to include applications and computer-integrated learning activities to enhance learners' achievement.

Inasmuch as iPad-integrated instruction was found more effective in developing learners' Science Achievement, it is recommended that iPad should be utilized by teachers as a vehicle towards attaining instructional objectives. On the other hand, hands-on activities should be strengthened in order to develop learners' Science Process Skills.

Students may be encouraged to be authors of their own learning by discovering techniques on how to better use technological tools in enhancing their learning and skills.

Finally, parallel studies utilizing different groups and levels of students may be conducted.

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