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Model for Web-based Learning Module in Senior High School General Chemistry

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Abstract

The CoViD-19 pandemic has brought challenges in the learning continuity of school children. New normal learning amidst the current pandemic demands the use of technology and the internet. This study aimed to determine if the web-based learning modules (WLM) have significant effects on the performance of the students in Senior High School (SHS) General Chemistry 1. Before utilizing the WLM, the students got lower actual mean of 23.66 in the pretest which was 6.34 lower than the hypothetical mean. Results further revealed that the students who used WLM got an actual mean of 48.42 in the post-test which was 18.42 higher than the hypothetical mean. Moreover, the students in the WLM acquired a mean gain of 24.75 with a standard deviation of 4.21. The study found a significant mean gain between the pretest and posttest performance of the Grade 11 students in General Chemistry 1 using the WLM. The results affirmed a great improvement in the performance of the students from the pretest to the posttest. The results imply the use of WLM as a great supplemental learning tool that allows learners to go through the material at their own pace exploring the contents of the modules. Thus, the model for the module development can be used in the teaching and learning across the grade level curriculum.

Keywords: *new normal learning, web-based learning materials, flipped classroom*

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1. Introduction

It is undeniably true that today instruction using the computer is widely used and accepted by the students, but its effectiveness in helping the school learners is still questionable. The traditional classroom pedagogies are put into question with the advent of technology (Guarino et al., 2014). As educators, it is very important to adopt the unceasing revolution in the use of technology in the classroom. It is imperative for educators to prove that the use of technology in the classroom results in sufficient or exceeding student success (Bailey et al., 2001; Johnson et al., 2016). In addition, it is a necessity to identify the learners' behaviors and attitudes that promote quality learning in the technologically-based community so that educators can give differentiated instruction to school learners (Bailey et al., 2001; Nelson, 2017).

The availability of online and offline educational materials and the accessibility of technology and internet connectivity in classrooms have changed educators' attentions to online learning and computer-assisted instruction (Anglin & Morrison, 2000; Apuke & Iyendo, 2018). With the capacity to access offline, online, and interactive educational materials from the internet and web-based connection, lawmakers, parents, and educators are considering the internet as an effective and efficient method of leveling the teaching and learning process in the classroom (Francek, 2000; Apuke & Iyendo, 2018), and providing the conducive learning environment for each 21st-century learner (Roth, 1999; Svetcov, 2000; Ng, 2021). Moreover, online learning materials and strategies, like game-based learning**,** mobile learning, online courses, and blended learning, are the latest inclusion in the higher-education resources. These have the strong grip of expanding, enhancing, and strengthening learning for school learners.

Traditional and online learning create an impression on their exciting attributes and evolving functions that may or may not have effects on student achievement. Some promoters for online learning assert that technology-assisted learning is superior to traditional teaching-learning methods (Milliron, 2010). However, Angiello (2010) believes that the bottom line between the issues of online and traditional learning is that educators should understand the effectiveness of online learning before scarce resources are spent. This idea is congruent with a study conducted by Means et al. (2009), which concluded that students who took part in their classes online pulled off better than students in the usual face-to-face instruction. According to Bork (2014), the computer is meant to be a meaningful factor in learning at all levels with all types of school learners. Primarily, the main factor is involvement and interaction. The computer

can create learning an active method, as contrast to a passive method, that signifies meaningful results.

According to Deloatch (2015), technology changes the way children (who are the learners) think and feel. School children who are always engaged in the use of search engines may be good at looking for information—but not at remembering it. Moreover, schoolchildren who utilize technology do not have the chances or opportunities to be creative and imaginative or to be critical thinkers. It is also observed that the number of hours that adolescents spend using technology is increasing. They always take part in socialization and interaction. A greater concentration signifies the adolescents' involvement in activities on social networking sites. The adolescents who are also school children enjoy interacting with others on social networking sites and they may not anymore be doing the tasks they are supposed to do like studying (Roois et al., 2011). A high level of involvement in social networking sites makes school learners lose focus on school curricular activities and affects their academic performances (Simuforosa, 2013).

The computer is vastly used in education, either training or adult and formal education. However, integrating technology in education in the Philippines has produced misconceptions. Technology literacy is only meant for the ability to use basic office tools. This intensely demands the procurement of computer hardware and software. This situation does not only require a big cost in education but creates also issues on accessibility and availability. The technology in the school is also utilized only for communication, grading, enrolment, and accounting (Matulac, 2013).

The rapid expansion of the Internet and the diverse capabilities of computer software and hardware are influencing the dynamics of teaching and learning on many different levels (Wasim et al., 2014). Online learning, which is often called web-based learning, has been widely used in many schools globally. The proliferation of web–based learning has sparked numerous studies exploring and determining different variables that may influence the learning experience among learners (Kim & Moore, 2005). However, the study of Zahroh (2020) showed that web-based module did not have a significant positive impact on student learning outcomes. Dinc (2017) argued that a well-designed educational website help learners enhance their online learning experience through interactive designs. For a successful web-based learning experience, Schrum and Hong (2002) identified several student factors such as technology experience, access to tools, learning styles, study skills and habits and skills, student's goals, lifestyle factors and

student's personal traits. Unlike the classroom environment, web-based learning is much easier to design and implement the instruction according to the learners` preferences. Integrating various media elements such as, text, sound, video and dynamic illustrations can foster the elaboration of complex subject matters (Mustafa, 2005). According to Chiriac (2019), the design of the web-based learning is highly influenced by organizational, technological, pedagogical, and contextual approaches.

The threat of the pandemic changes a lot in the Philippine educational system (Castroverde & Acala, 2021). This pandemic may result in the longer-term adoption of the new normal in which the students and teachers face the burden of sustaining and continuing the teaching and learning process (Cortezano et al., 2021). The emergence of new normal learning amidst the current pandemic demands the use of technology and the internet (Obana, 2020). The Department of Education (DepEd) has already mandated the use of distance learning modalities such as online synchronous and asynchronous learning and digital and printed self-learning modules.

The current situation of the Philippines is true to the schools of Cebu City. Since face-to-face learning is impossible for most schools, the Department of Education (DepEd) issued the DepEd Order Number 12, s. 2020 on the "Adoption of the Basic Education Learning Continuity Plan (BE-LCP) for School Year 2020-2021 in Light of the COVID-19 Public Health Emergency". This reiterates the learning delivery modalities that schools can adopt depending on the COVID-19 restrictions and the particular context of the learners in the school or locality. Distance learning is the common learning delivery modality that a school can adopt due to numerous travel, gathering and health restrictions imposed by the government. Distance learning refers to a learning delivery modality where learning takes place between the teacher and the learners who are geographically remote from each other during instruction. This modality has three types: Modular Distance Learning (MDL), Online Distance Learning (ODL), and TV/Radio-Based Instruction. The MDL involves individualized instruction that allows learners to use self-learning modules (SLMs) in print or digital format, whichever is applicable in the context of the learner, and other learning resources like learner's materials, textbooks, activity sheets, study guides, and other study materials. Meanwhile, ODL features the teacher as facilitator, engaging learners' active participation through the use of various technologies accessed through the internet while they are geographically remote from each other during

instruction. TV/Radio-Based Instruction utilizes SLMs converted to video lessons for Television-Based Instruction and SLMs converted to radio scripts for Radio-Based Instruction. The most commonly used modality in the public school system is the MDL due to its simplicity and ease of reproduction however students' performance dropped (Dargo & Dimas, 2021). Thus, this study considered the use of ODL.

Although there are already digital self-learning modules in Chemistry, no available web-based self-learning modules are interactive and advanced to improve learning experience. The implementation of web-based learning makes the instruction process faster and more accessible and upgrades teachers' methods and strategies in teaching and enhances students' learning performance (Ayuyang, 2019). Similarly, Khalifa and Lam (2002) found that web-learning environments have made learning much more convenient and provided the learner with more exploration and interactivity capabilities. In fact, in the study of Chen et al. (2010) found a general positive relationship between the use of the learning technology and student engagement and learning outcomes. In chemistry classes, the web-based learning environment has the potential to enhance the comprehension of chemistry concepts (Cahyana & Supatmi, 2019), students' attitudes and interests, and to increase students' awareness regarding the relevant aspects of chemistry to daily life (Frailich et al., 2007).

This study develops a model for the web-based learning module (WLM) on senior high school general chemistry based on the calculated effects of the WLM on the performance of the students through the pretest and posttest. The study tested the following hypotheses:

HO1: There is no significant difference between the hypothetical mean and the actual mean of the pretest and posttest performance of the students in Grade11 General Chemistry 1 using the WLM.

HO2: There is no significant mean gain from the pretest and posttest of the students' performance in General Chemistry 1 using the WLM.

2. Methodology

Research Design

This study was conducted based on an experimental method of research utilizing one group pretest-posttest design where one group of Grade 11 STEM students was exposed to web-

based learning modules and paper-based learning modules. The research design was diagrammed as follows:

RG_1 O_1 X_1 O_2

where:

RG_1 - randomized group exposed to WBLM,

O_1 - pretests,

O_2 - post-tests

X_1 - WBLM Technique

Participants

The participants of the study were 32 senior high school students at Mabolo National High School, one of the biggest schools in the city. The school is under the K to 12 Basic Education Curriculum of the Department of Education, Division of Cebu City. These participants were Grade 11 students under the Science, Technology, Engineering and Mathematics (STEM) strand of the academic track of DepEd Senior High School curriculum. There was only 1 section of the STEM class with a total of 38 students. The study used complete enumeration but six students were dropped from the participants due to their absence and disengagement. The participants consisted of 12 boys and 20 girls whose ages were between 16 – 19 years old.

Instrument

In order to measure the effects of the web-based modules on the academic performance of the students, this study utilized a 50-item test in Grade 11 General Chemistry 1. The test was based on the DepEd Teacher's Manual. The contents of the pretest and post-test were the same with disparity on the sequence of the questions.

For the content validity of the test, the study followed the suggested modules provided by the DepEd and consulted different experts on General Chemistry for suggestions. The corrections and refinement of the research instrument was done after the feedback.

Data Gathering Process

The data gathering process involves several stages for the 8-week experimental period.

Development of Web-based Modules. This research utilized modules provided by DepEd Cebu City Division and other available references. A variety of available online simulations, videos, and interactive quizzes were utilized and linked to Google Forms carefully. The created Google Form, which has contents similar to that of the modules provided by DepEd, served as the web-based learning modules. The development of WLM was based on the most essential learning competencies (MELCs) in General Chemistry 1 issued by the Department of Education. There were eight WLMs developed for General Chemistry 1 before the opening of the first day of classes for the School Year 2020 – 2021.

Implementation of the Pretest. Prior to data gathering and implementation of the pretest, a letter was sent to the School Head for approval to conduct the research. Upon the approval of the request, the experiment was conducted. The experimental period took effect on the first day of the first grading period of the School Year 2020 – 2021. The pretest was conducted on the first day of the class. The pretest was based on the General Chemistry 1 MELCs. The questions were encoded in Google Forms and the link was sent to the students. The students accessed and took the pretest by clicking the given link.

Utilization of the Web-based Modules. The students were given web links in order to access the WLM. With the students using WLM, the teacher acted as a facilitator who only assisted the students in the process of learning like answering questions regarding the web-based learning module's content and functionality via online and face-to-face communication. The process of learning in this method was the sole responsibility of the students. They actively studied the contents of the modules and validated their learning by answering the provided exercises and looking into other online references and discussions. With the use of WBLM, the process of students' learning was assessed by individuals and by groups depending on the level of difficulties of the subject matter. The students used the WLM for two months. The students used the eight WLMs to achieve the General Chemistry 1 MELCs. These eight WLMs have activities that students need to answer. The students needed to access and answer one WLM every week.

Implementation of the Posttest. After eight weeks of utilizing WLM, the students took the posttest. The posttest was also based on the General Chemistry 1 MELCs. The questions were encoded in Google Forms and the link was sent to the students. The students accessed and took the posttest by clicking the given link.

Data Analysis

The following statistical treatments were utilized: z-test for single and large sample and t-test.

3. Results and Discussion

Table 1

Pretest Performance of the Grade 11 Students in General Chemistry1

Group	N	H. M.[a]	A. M.	SD	Test Statistics		Qualitative Description
					Computed z-test	Tabled Value	
WLM	32	30	23.66	2.97	12.08*	1.96	Below Average

**Significant at α =.05, z ≥ 1.96. [a]Hypothetical Mean was based on the 60% of the test items which is equivalent to 75% standard criterion DepEd*

Table 1 exhibits the hypothetical mean and the actual mean of the performance of the Grade 11 students in General Chemistry 1 before they were given and exposed to WLM. Based on the results, the students under WBLM got an actual mean of 23.66 which was 6.34 lower than the hypothetical mean. The computed z-test of 12.08 at $\alpha = .05$ was greater than the tabled value of 1.96. This was significant, thus Ho_1 was rejected. This meant that there was a significant difference between the hypothetical mean and actual means of the students. The students' performance before the conduct of the experiment was 'Below Average'. The students' performance before they were given and exposed to WBLM did not reach the standard performance of 60%. The below-average performance of the Grade 11 students in General Chemistry 1 implied that the students had little or no knowledge on the subject matter at all since this was still a pretest. The students did not master the pre-requisites or learn Chemistry in the lower grade levels. This finding supports Sudha and Amutha (2015) that the students in the Chemistry class usually have poor performance in the pre-test. The result is also similar to the studies of Sirhan (2007), Childs and Sheehan (2009), and Johnstone (2000) that Chemistry is mostly regarded as a difficult course or subject for students.

Table 2

Posttest Performance of the Grade 11 Students in General Chemistry 1

Group	N	H. M.[a]	A. M.	SD	Test Statistics		Qualitative Description
					Computed z-test	Tabled Value	
WLM	32	30	48.42	2.01	51.81*	1.96	Above Average

**Significant at α =.05*

Table 2 provides the hypothetical and the actual means of the performance of the Grade 11 students in General Chemistry 1 in WLM. Results revealed that the students who used the WBLM got an actual mean of 48.42 which was 18.42 higher than the hypothetical mean. The computed z-test of 51.81 was greater than the tabled value of 1.96 at α = .05 for the WLM. Thus, Ho_1 was rejected. This indicated that there was a significant difference between the hypothetical mean and actual means of the students. The performance of the students after the implementation of the WLM was 'Above Average'. The Grade 11 Students in General Chemistry 1 surpassed the standard performance of 60%. The above-average performance was attributed to the fact that the new strategy was effective and helpful to the students' fast comprehension and easy absorption of the concepts of the lesson. The posttest performance of the students supported the studies conducted by Bailey et al. (2001), Huang (2014), and Rich and Guy (2013) which showed above average students' performance in the post-test. During the pandemic period, Rachmadtullah et al. (2020) and Sefriani et al. (2021) used the same technique and affirmed the improvement of the performance of the students from pretest to posttest. This finding encourages students to integrate WLM as advanced technology for every lesson so that they can become creative and active in improving knowledge and skills (Ali et al., 2019).

Table 3

Mean Gains in the Pre and Posttests Obtained by the Grade 11 Students in General Chemistry 1

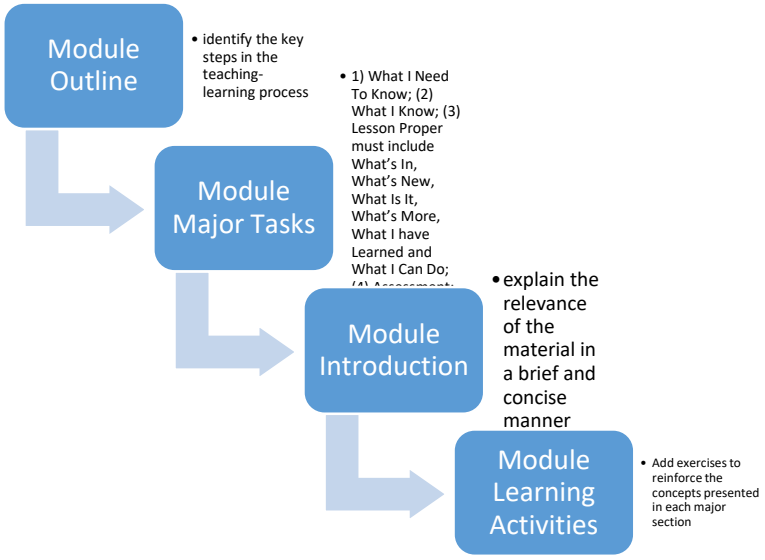
Group	N	Pretest Mean	Posttest Mean	$\bar{d}$	S_d	Test Statistics	
						Computed t-tests	Tabled value of t at α = .05 with (n-1) df
WLM	32	23.66	48.42	24.75	4.21	33.74*	2.04

**Significant*

Table 3 contains the results of the computation of the pretest and post-tests means, mean gains, standard deviations and the computed t-tests in Chemistry. The students in the WLM acquired a mean gain of 24.75 with a standard deviation of 4.21. The computed t-tests of 33.74 was greater than the tabled value at a 5% level of significance. This rejected Ho_2 on the significant mean gain between the pretest and posttest performance of the Grade 11 students in General Chemistry 1 using the WLM. This meant that there was a great improvement in the performance of the students from the pretest to the posttest. The findings of this study affirmed Caine and Caine (1990) on their theories that the learners learn best when they are active engager of the activity and build their knowledge through experiences that enable them to create schemas mental models in their heads. Similarly, Ayuyang (2019) explained that the learners can improve their performance in the subject because of their interaction with the contents of the web-based learning environment. As to the WLM, Rachmadtullah et al. (2020) assert that this kind of learning offers almost all facilities with the delivered comfort of a learning experience tailored fit for the learners' schedule. Moreover, the findings of this study also confirmed Knowles (1975) who theorized that self-directed learners control their own learning processes while the instructor simply helps the learner by providing a rich environment from which the learner can learn best and the experiences of each learner come from within each individual learner. Thus, this leaves each learner motivated to solving of each problem related to the topics or concepts of the subject matter.

Figure 1

Conceptual Model of Designing a Web-based Learning Module



The WLM is a great supplemental learning tool. It allows the learners to go through the material at their own pace navigating through the pages of the module. It also helps maintain attention due to the interaction with the learner and the module itself. The learner can return to the module after going through it and navigate through the module to review past information whenever they desire. The module contains a test to measure how much the user has learned after going through the module and help point out the important parts of the module depending on how it is set up.

The use of web-based learning modules in teaching General Chemistry 1 produced the above-average performance of the students in the subject and promoted a more positive attitude of students. Hence, the guidelines are formulated as the model for a WLM.

Outline the session. The most important element in an effective web-based learning module is the way in which it is organized. The learners need to know the prospective major tasks in the lesson at hand. This helps learners recognize and remember the most important elements in the process. Use the outline to identify the key steps in the teaching-learning process. Aim for five to eight sections per module, including the introduction and summary sections.

Create sections for major steps in the process. Design the learning module so that each major task is its own section. In developing a web-based learning module using Google Forms, for example, the main sections might be (1) What I Need To Know; (2) What I Know; (3) Lesson Proper must include What's In, What's New, What Is It, What's More, What I Have Learned and What I Can Do; (4) Assessment; (5) Additional Activities; and (6) References.

Create brief and concise introductions. The introduction of the learning module sets the stage for everything that follows. In creating an introduction of the module, it is a must to establish the what's, how's, and the why's for the students. There is a must to explain the relevance of the material in a brief and concise manner so that the learners will understand the relevance of the web-based modules to their learning. There is a must to state the objectives, and cite the activities of the modules clearly so the learners will anticipate what they will learn in the course.

Reinforce the learning in each section with exercises. One of the great advantages of working in a self-directed, online learning environment is that students can accomplish exercises during the course to assess their own learning and determine what they need to review. Add

exercises to reinforce the concepts presented in each major section. With these exercises, students evaluate different scenarios and apply what they have learned. Other exercises include multiple-choice, sorting, or interactive activities which are expedient in student learning.

4. Conclusion

This study developed a model for the web-based learning module (WLM) on senior high school general chemistry based on the calculated effects of the WLM on the performance of the students through the pretest and posttest. This study was conducted based on an experimental method of research utilizing one group pretest-posttest design where one group of 32 Grade 11 STEM students was exposed to web-based learning modules.

Before utilizing the WLM, the students got an actual mean of 23.66 in the pretest which was 6.34 lower than the hypothetical mean. Results in this study revealed further that the students who used the WLM got an actual mean of 48.42 in the post-test which was 18.42 higher than the hypothetical mean. Moreover, the students in the WLM acquired a mean gain of 24.75 with a standard deviation of 4.21 which means there is an improvement in their academic performance from pretest to post-test.

As the WLM produced better performance and developed a more positive attitude towards the subject, the study recommends the use of the WBLM in science subjects and in other discipline. It can also be used as an alternative approach in the Alternative Learning System and Alternative Delivery Mode of Instruction. Since this research was limited to Mabolo National High School, further studies can expand the research environment and respondents and may consider web-based learning modules in teaching subjects like Araling Panlipunan, English, Filipino and Mathematics, and other branches of science like Physics, and Biology.

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