Performance Of Second Year General Chemistry Students in The College of Teacher Education

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Abstract — This study was focused on assessing the validation and implementation of learning modules in General Chemistry teaching in the three courses during the school year 2021-2022. It determined the performance level of the learners in General Chemistry before and after implementation of the said learning modules through a pretest and posttest. The level of performance of the General Chemistry learners during the pre-test was way below the 75% standard. The mean percentage score of the General Chemistry learners along posttest exceeded the 75% mastery level prescribed by the DepEd. There is a significant difference between the level of performance of grade 7 learners in the pre and post-test results in General Chemistry during the school year 2021-2022. The computed value is greater than the tabulated value, therefore the null hypothesis is rejected. On the evaluation of the learning modules, the learners encountered learning difficulties by obtaining low mastery in four of the competencies in General Chemistry which were the bases in implementing the developed modules. The learning modules were rated "Very Satisfactory" by the expert- evaluators. The modules are effective for use of General Chemistry learners. Thus, the learning modules in General Chemistry should be recommended for use by the learners in the school not only in the three courses but all learners taking up General Chemistry. Also, teachers in other areas of discipline should also develop other forms of instructional materials and recommend them for validation for successful teaching-learning outcomes.

Keywords — General Chemistry, Learning, Module, Performance, Assessment

I. Introduction

These days, there is a move toward modular approach to curriculum implementation. The approach has drawn special attention in most nations' education system particularly in technical and vocational education and higher education (Malik, 2012). Masvaure (2019) in his paper eclectically expounded the perspectives of several authors indicating that instructional materials are essentially made as instruments in igniting and completing the teaching-learning process gearing towards the most perceivable learners' outputs dictating the most ideal outcome, correlating to how Ajoke (2017) referred to them as objects or devices which help the teacher to make a lesson much clearer to the learner.

Modularization is based on the principle of dividing the curriculum into small discrete modules or units that are independent, no sequential, and typically short in duration. Learners accumulate credits for modules which can lead to the qualification for which a specified number of credit point is required. Malik (2012), module is a unit of work in a course of instruction that is

virtually self-contained and a method of teaching that is based on the building up of skills and knowledge in discrete units. Therefore, a module is a course that together with other related courses can constitute a particular area of specialization. Each unit or module is measured part of an extended learning experience leading to a specified qualification(s) "for which a designated number, and normally sequence, of units or modules is required."

Cortez (2013) also deals with the development and validation of the learning module in plane trigonometry that results to a very high valid in terms of objectives, contents/ subject matter, organization/ presentation, illustrations/ examples, graphics and evaluative exercises. Modular approach to teaching enables the students to have control over his/her modules is more appropriate for more mature learners. In modular approach, all the capabilities required to learning and accepts greater responsibility for learning. It demands greater maturity on the part of the learner, the perform are closely related. Sets of tasks are grouped together. For instance, capabilities required managing an institution's finances which includes generation of finances, allocation, accounting, and monitoring can be grouped together and form a module called financial management. For effective teaching of science subjects, the use of instructional materials to enrich instruction is very vital (Chukwunazo et al., 2022).

Balaguer (2012) discussed several options in deciding what teaching materials to be considered: choosing a suitable published course; adapting a published course to match the needs of the course and using teacher-made materials and authentic materials as the basis for the course. As cited by Balaguer (2012), teachers who believe that the use of instructional materials accomplishes something special for their learners would do well to consider carefully what those outcomes might be, and then to find ways to measure them. According to Adewale (2011), instructional material will help the teacher to hold the learner's attention in class. This is because learners believe in their teacher who teaches objectively as it will helps learners understand the mechanism of learning. Instructional materials are things which are intended to help the teacher to teach more effectively.

Emezie (2010) stated that instructional materials include those materials and services used in learning situations to supplement the written or spoken words in the transmission of knowledge, attitude, and ideas. It is a material that facilitates teaching and learning activities and consequently the attainment of the lesson objectives. It helps I make teaching and learning real and meaningful.

Shapovalenko (2010) defined "instructional materials" as items having intellectual content that is designed as a major tool for assisting in the instruction of a subject or course. These items may be available in any form of textbooks, consumables, learning laboratories, manipulative, electronic media, modules, and computer courseware or software.

Ferrer (2009) concurred that technological advancement, technological innovation increased globalization, shifting workforce demands, and pressures of economic competitiveness, these are some challenges that are changing the world. These challenges are redefining the skill

sets that the learners need to be adequately prepared to contribute to today's society. Moreover, Dela Cruz, et al. (2024), technology has tremendously influenced language through social networking sites, made it simple for individuals to communicate, and rendered human beings heavily dependent on what it offers. Because of its creative potential, the internet will be able to capture linguistic diversity more thoroughly and accurately than ever before, opening up new channels for expression.

Ahmed et al. (2012) contend that secondary school students performed poorly in biology because instructional materials are not adequately available and sometimes might be available but are not adequately utilized. Nuhu et al. (2021) lamented that mastery of biology concepts might not be fully achieved without the use of instructional materials. Relevant and appropriate instructional materials help to arouse and sustain interest and help to concretize ideas and stimulate the imaginations of the students, thus enhances achievement of students in a subject (Mustapha et al., 2022).

Ali (2010) made a study on the "Effectiveness of Modular teaching of Secondary Level". The major purpose of the study was to explore the impact of modular the branch of General Chemistry that deals with the identification of the substances of which matter is composed; the investigation of their properties and the ways in which they interact, combine, and change; and the use of these processes to form new substances. Chemistry is the branch of General Chemistry that deals with the properties, composition, and structure of elements and compounds, how they can change, and the energy that is released or absorbed when they change.

This idea states the established learning environments that are responsive to the learners' diversity-interactive environments that are learning-focused and that efficiently manage the learners' behavior in physical and virtual spaces through the use of polymedia. Students learn more if there is a practice of these modern adaptations of modalities. With the incorporation of different media, the senses of the learners are used, which makes them learn at a concrete level and learn more when the texts being taught to them are presented in a manner that makes them more physically encouraging and appealing (Delos Reyes, 2020).

The great challenge in chemistry is the development of a coherent explanation of the complex behavior of materials, why they appear as they do, what gives them their enduring properties, and how interactions among different substances can bring about the formation of new substances and the destruction of old ones. From the earliest attempts to understand the material world in rational terms, chemists have struggled to develop theories of matter that satisfactorily explain both permanence and change. The ordered assembly of indestructible atoms into small and large molecules, or extended networks of intermingled atoms, is generally accepted as the basis of permanence, while the reorganization of atoms or molecules into different arrangements lies behind theories of change (Gregorio, 2005).

Every substance, whether naturally occurring or artificially produced, consists of one or more of the hundred-odd species of atoms that have been identified as elements. Although these atoms, in turn, are composed of more elementary particles, they are the basic building blocks of chemical substances; there is no quantity of oxygen, mercury, or gold, for example, smaller than an atom of that substance. Chemistry, therefore, is concerned not with the subatomic domain but with the properties of atoms and the laws governing their combinations and how the knowledge of these properties can be used to achieve specific purposes.

Over time a group of chemists with specialized research interests become the founding members of an area of specialization. The areas of specialization that emerged early in the history of chemistry, such as organic, inorganic, physical, analytical, and industrial chemistry, along with biochemistry, remain of greatest general interest. There has been, however, much growth in the areas of polymer, environmental, and medicinal chemistry during the 20th century.

Moreover, new specialties continue to appear, as, for example, pesticide, forensic, and computer chemistry. Skills in Science such as observing, identifying, classifying, designing, collecting data, interpreting data, forming results and formulating conclusions are skills important to science.

Science, technology, and innovation each represent a successively larger category of activities which are highly interdependent but distinct. Science contributes to technology in at least six ways: (1) new knowledge which serves as a direct source of ideas for new technological possibilities; (2) source of tools and techniques for more efficient engineering design and a knowledge base for evaluation of feasibility of designs; (3) research instrumentation, laboratory techniques and analytical methods used in research that eventually find their way into design or industrial practices, often through intermediate disciplines; (4) practice of research as a source for development and assimilation of new human skills and capabilities eventually useful for technology; (5) creation of a knowledge base that becomes increasingly important in the assessment of technology in terms of its wider social and environmental impacts; (6) knowledge base that enables more efficient strategies of applied research, development, and refinement of new technologies.

The converse impact of technology on science is of at least equal importance: (1) through providing a fertile source of novel scientific questions and thereby also helping to justify the allocation of resources needed to address these questions in an efficient and timely manner, extending the agenda of science; (2) as a source of otherwise unavailable instrumentation and techniques needed to address novel and more difficult scientific questions more efficiently (Kamakshi, 2011).

The scientific method is an ongoing process, which usually begins with observations about the natural world. Human beings are naturally inquisitive, so they often come up with questions about things they see or hear and often develop ideas (hypotheses) about why things are the way

they are. The best hypotheses lead to predictions that can be tested in various ways, including making further observations about nature. In general, the strongest tests of hypotheses come from carefully controlled and replicated experiments that gather empirical data. Depending on how well the tests match the predictions, the original hypothesis may require refinement, alteration, expansion or even rejection. If a particular hypothesis becomes very well supported a general theory may be developed.

Although procedures vary from one field of inquiry to another, identifiable features are frequently shared between them. The overall process of the scientific method involves making conjectures (hypotheses), deriving predictions from them as logical consequences, and then carrying out experiments based on those predictions. A hypothesis is a conjecture, based on knowledge obtained while formulating the question. The hypothesis might be very specific, or it might be broad. Scientists then test hypotheses by conducting experiments. Under modern interpretations, a scientific hypothesis must be falsifiable, implying that it is possible to identify a possible outcome of an experiment that conflicts with predictions deduced from the hypothesis; otherwise, the hypothesis cannot be meaningfully tested.

The existing instructional materials in teaching general chemistry in Urdaneta City University need to be supplemented with other materials through this research study.

Literature Review

This study is anchored on Gagne's Condition of Learning Theory which is based on a hierarchy of intellectual skills organized according to complexity that can be used to identify prerequisites necessary to facilitate learning at each level. Through this, instruction can be more efficient by following the sequence of nine instructional events defined by the intellectual skills that the students are required to learn for the specific task at hand.

This model focuses more on the part of the learners. Gagne introduced the idea of task analysis to instructional design. Through task analysis, an instructional task could be broken down into sequential steps – hierarchical relationships of tasks and sub-tasks. This theory is built on the principle of the systems approach which Skinner explored in programmed instruction.

Another theoretical basis of this study is that of Bruner's Constructivist Theory which asserts that learning is an active process in which learners construct new ideas based upon their current knowledge and their personal experiences. A cognitive structure is defined as the mental process which offers the learners the ability to organize experiences and derive meanings from them. These cognitive structures allow the learners to push past given information in constructing their new concepts.

Instruction can be more efficient by providing a careful sequencing of materials, translation of materials to be learned into a format appropriate to the learners' current state of understanding

and organized it into a spiral manner to allow learners to build or construct hypothesis, to make decisions, and continually builds upon what they have already learned.

John Dewey's learning by doing theory emphasized that learning is good if it provides experiences that ensures understanding, while for good teaching requires good environment of instructional materials and devices that will motivate the attention of the learner, stimulate thinking, and facilitate understanding that could make learning more worthwhile. In addition to Dewey's point of view, teaching is also good when the method used is supplemented by another method and devices. The learners' learning should be organized, sequenced, and supervised by the teacher so that new knowledge and skills are consistently gained, as part of the educator to provide both meaningful materials and clinical experience for the learners.

Another way of providing rich experiences for learners in science is to provide more reading materials aside from the basic text. There is a great wealth of non-graded materials that can be used to provide extensive reading experiences to learners of science. Some of these are the popular books that provide for a wide range of reading experiences in terms of both reading difficulty and subject matter. When these reading materials are made available, it has been found out that their reading interests tend to broaden.

Instructional materials facilitate teaching strategies, the need to update instructional materials is necessary for stability, acceptability, and relevance to the need of the learners to enhance their performance, quality of the developed instructional material should be considered. Instructional materials allow the instructor to engage learners by supporting concepts through the use of multimedia, including sound clips, video, images, hands-on experience and interactive games. Materials offer learners the opportunity to practice concepts and develop a product that demonstrates their level of understanding. Consequently, those products are then used to evaluate learners' knowledge. Instructional materials allow the instructor to support learners with varying levels of ability and foundational skills by providing additional support.

In general, the theoretical framework of this study will be geared towards these Theories. The Theory of learning is based on the need to facilitate knowledge rather than teach it in traditional sense. Constructivism (learning theory has influenced in the field based on observation and scientific study about how people construct their own understanding and knowledge on the world, through experiencing things and reflecting of those experiences. Instructional Theory. Instructional Design also called Instructional System Design (ISD) is the practice of creating instructional experiences which make the acquisition of knowledge and skills more efficient, effective, and appealing. The process consists broadly of determining the current state and needs of learner.

Therefore, in the context that the researcher recognizes the importance of instructional materials in facilitating the teaching strategies and application of teaching strategies in the attaining quality education. There is a need to upgrade the instructional materials to meet the demands of

science teaching, therefore there is a need to develop a module in general chemistry to enhance the learners learning.

The development of the chemistry module will be done through bibliographical research, planning, and organizing and developing the draft. The implementation phase includes chemistry teachers to implement the developed modules in General Chemistry in Urdaneta City University.

II. Methodology

This study used the descriptive - developmental method of research to ascertain the performance level of college learners in General Chemistry. A descriptive method was used to describe factors and identify reasons behind respondents' participation. In addition, descriptive quantitative is used to analyze and interpret data collected using an instrument (Delos Reyes, et al., 2023). The sources of data were taken from the analysis of the pre-test results, during the first semester, school year 2021-2022. This study was conducted in Urdaneta City University. There were two groups of respondents of this study namely the learners and the experts in General Chemistry.

On the level of performance of the General Chemistry learners based on the pre- test and post test result during the school year 2021-2022, the Mean Percentage Score (MPS) was used.

On the learning difficulties in science 7 based on the itemized analysis of the pre-test results, Percentage of Correct Response (PCR) was used. The itemized analysis results were interpreted using the percentage of correct response (PCR). The results of the itemized analysis were described using a 4-point scale as shown below:

Scale	Percentage of Correct Response	Descriptive Equivalent
4	75% and above	Mastered (M)
3	50% - 74%	Nearing Mastery (NM)
2	25% - 49%	Low Mastery (LM)
1	below 25%	No Mastery (NM)

On the significant difference between the level of performance of General Chemistry learners in the pre- test and post test results after implementation, Z-test was used.

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{SD_1^{\,2} + SD_2^{\,2}}{N}}}$$

Where,

Z= Z test;

X_1= mean of the first;

X_2= mean of the second

SD_1^2= Variance of the first mean;

SD_2^2=variance of the second mean

N = no of population

On the level of performance of the General Chemistry learners after implementing the modules, the Mean Percentage Score was used.

III. Results and Discussion

The mean percentage scores were used in describing the learners' level of performance in General Chemistry. The Pre-test result for the first semester, school year 2021-2022 and the average mean percentage scores (MPS) of the three courses is 57.73% (See in table 1).

Table 1
Pre-Test Results for SY 2020-2021
N=100

Course	MPS
A	60.45
B	59.44
C	53.29
MPS	57.73

Course A has obtained a mean percentage score of 60.45%, Course B obtained a mean percentage score of 59.44%, and Course C has obtained a mean percentage score of 53.29%. Based on the result, the mean percentage scores obtained in General Chemistry by the learners in the three courses was way below the prescribed mastery level of 75% set by the Department of Education. It could be deduced from the said results that the learners encountered learning difficulties in General Chemistry, that is why the researcher delved further to find what these difficulties were and that the learning modules that was developed by the researcher can be proposed to the different courses to be adopted to address these learning difficulties.

Table 2 shows the result of the post-test after implementation of the learning modules.

Table 2
The Post-Test After Implementation of the Learning Modules
N=100

COURSE	MPS
A	76.50
B	80.00
C	76.57
MPS of the three courses	77.69

Course A has obtained a mean percentage score of 76.50%, Course B obtained a mean percentage score of 80.00%, and Course C has obtained a mean percentage score of 76.57%, with an average mean percentage score of 77.69%.

There was an increase on the result of the posttest and the result exceeded the 75% standard set by the Department of Education. This indicates that the learning modules help improve the performance of learners in General Chemistry, therefore it is effective.

Table 3 reveals the results of the evaluation of the learning modules to the learners.

Table 3
Evaluation of the Learning Modules in General Chemistry by the School Administrators

Content	LM 1 Rating	DE	LM 2 Rating	DE	LIM 3 Rating	DE
1. Content is suitable to the student*s level of development.	4.00	VS	4.00	VS	4.00	VS
2.Materials contributes to the achievement of specific objectives of the subject area and year level for which it is intended.	4.00	VS	4.00	VS	4.00	VS
3.Material provides for the development of higher cognitive e skill such as critical thinking, creativity, learning by doing, inquiry, problem solving. etc.	4.00	VS	4.00	VS	4.00	VS
4.Material enhances the development of desirable values and traits.	4.00	VS	4.00	VS	4.00	VS
5.Material is free of ideological, cultural, religious, racial, and gender biases and prejudice	4.00	VS	4.00	VS	4.00	VS
6.Material has the potential to arouse interest of target reader.	4.00	VS	4.00	VS	4.00	VS
7.Adequate warning /cautionary notes are provided in topics and activities where safety and health are of concern.	3.67	VS	3.67	VS	3.67	VS
Mean	3.95	VS	3.95	VS	3.95	VS

Legend: LM1=Learning Module 1 LM3 = Learning Module 3

LM2 = Learning Module 2 LM4= Learning Module 4

Scale	Mean Value	Descriptive Equivalent
4	3.50 - 4.49	Very Satisfactory(VS)
3	2.50 - 3.49	Satisfactory(S)
2	1.50 – 2.49	Poor(P)
1	1.00 – 1.49	Not Satisfactory(NS)

As to Content, on Table 3 it could be gleaned the results of the evaluation of the learning modules to the learners that the learning modules are rated "very satisfactory" as evidenced by the over-all average weighted means of 3.95 respectively. The learning modules in General Chemistry could be considered as appropriate instructional material to address the learning difficulties of learners. Based in these results, it could be concluded that based in the evaluation results of the learning modules in General Chemistry could still be further improved on certain criteria so that the intention of addressing the learning difficulties of learners in General Chemistry could be achieved.

IV. Conclusion

Based on the findings, it was concluded that the General Chemistry learners performed very low in the pre-test. The learners encountered learning difficulties by obtaining low mastery. In General Chemistry, it was the bases in implementing the developed modules. The post test result improves after implementing the modules. The z test result was greater than the computed value and there is significant difference. The learning modules were rated "Very Satisfactory" by the expert- evaluators. The modules are effective for use of the General Chemistry learners.

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