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Resource-based course guide in teaching general inorganic chemistry integrated with environmental concepts

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Abstract
The study developed and validated a Resource-Based Course Guide in teaching General Inorganic Chemistry Integrated with Environmental Concepts. Methodology includes development of the course guide validation of the instructional material. Students in the experimental class were taught based on the instructional strategies suggested in the course guide. Effect of the intervention on the conceptual understanding, thinking skills, laboratory skills and values development were determined. Results showed that the resource-based course guide is very good in terms of content, pedagogical and technical aspects. Students gain better conceptual understanding, laboratory skills, thinking skills, and environmental values were developed. The resource-based course guide in teaching general inorganic chemistry may be recommended for teachers' for them to provide their students with a friendly, student-centered learning environment that will better off chemistry education and promote science culture.

Keywords: Chemistry teaching, course guide, environment, chemistry achievement

1. Introduction

Education is an important tool in the nation's development. It can be an agent to economic progress and thus promote quality of life. The belief that education is an engine of growth rests on the quality and quantity of education (Olaniyan *et al*., 2008) [18]. The mission of the academe is to bring back the quality of basic education in all areas of learning particularly in science and technology. Countries wanting to improve their peoples' quality of life cannot escape the need to harness their science and technology capability as a way of developing competitiveness (Ibe and Ogena, 2012) [11]. The government recognizes the importance of developing its science and technology capability as a means of addressing the concerns of industrialization and globalization. The education sector is tasked to contribute to the achievement of the national development goals.

The goal of science education is to enable the learners to acquire knowledge, gain skills and develop attitudes that can ensure concept literacy and self-reliance that will further lead to application of these concepts and skills to real life situations (Salandanan, 1996). With the Philippines falling behind in establishing education as the main tool to realize national development and prosperity a different approach in finding solutions to the crisis in science education is in order. The results of the Philippine participation in the 3rd International Mathematics and Science Study (TIMSS) provided lessons for assessing our manner of delivering science education in the country.

The absence of a science culture is often cited as a major factor to students' low achievement in science along with lack of teachers' training, irrelevant curriculum, inadequate instructional materials and the learning process itself that relates to the teachers' pedagogical capability. Few teachers are competent enough to teach their subjects (Niebres, 1998) [17] and teachers' manuals intended to help teachers teach more effectively are inadequate.

With the advancement in technology as well as its indispensable role in development, it is therefore necessary to enhance capability of graduates in fields that are technology related. Science subjects such as Biology, Chemistry and Physics are primary concern for these are tools to development. It provides us with necessary knowledge, skills and attitudes to begin to approach problems in unique ways (Aikeinhead, 1997) [1]. Many important technological developments are made possible through a solid foundation in science. Application in agriculture, engineering, medicine and many other fields can be comprehended by someone who has a good basic understanding of Science. Greater challenge to Science education is evident.

Along this line, it is imperative that Science teachers must work in response to the challenge of Science education. Teachers are the most important component of the educational system. They are the prime mover, the main agent of change and the worker to realize the vision mission and goals of science education. They must take part in all academic activities particularly those that promote scientific literacy and science culture.

Every country in the world is now realizing the important role of instructional materials to quality education. Instructional materials development programs are now being implemented by various institutions. The Division of Elementary, Secondary, and Informal Education (ESIE) had included Instructional Materials Development (IMD) in their administered programs in support of the instructional needs of science, technology, engineering and mathematics (STEM) education. The program recognizes the need to align teacher content knowledge and pedagogical strategies, and assessment with the material to be developed.

One of the important concerns in Science education is the development of tools for meaningful learning (Mei-Hung Chiu, 2005). Mr. Gilbert Forbes of the Department of Education recognizes the need to develop instructional materials particularly on the core subjects. He pointed out that teachers must be trained and be given financial support in the development of more instructional materials such as modules, standardized tests, textbooks and others (Forbes, 2012). These materials will ease the work teachers and will serve as means to improve the quality of education. Ideal teaching learning process is considered interactive when learner, teacher and instructional materials interact with one another. Instructional materials are necessary to facilitate understanding of concepts.

Research has shown that chemistry teaching is unpopular and irrelevant in the eyes of the students (Hill *et al*., 2001); does not promote High Order Thinking Skills(Anderson *et al*., 1992); and leads to gaps between student wishes and teacher teaching (Hofstein *et al*., 2000). The stress on conceptual understanding and the appreciation of the nature of science tends not to be relevant for functionality in one's life. Paradigm shift, a shift of emphasis is needed. The shift must be from learning chemistry as a body of knowledge to promoting the educational skills to be acquired through chemistry. To better understand this issue of relevance of chemistry teaching, teachers must be guided and provided with relevant teaching materials (Holbrook, 2005) [10].

Resource-Based Learning (RBL) is an emerging instructional strategy that involves the use and application of available assets to support varied learning needs across contexts (Doiron and Davies, 1998) [4]. It is a view which gives prominence to the role of resources in the teaching learning process (Siu Cheung Kong, 2008) [21]. RBL is perceived as an opportunity to promote a view of learning as an active and shared process. The main advantage of resource-based learning is that it allows individual learner to progress at their own speed but on a specified path.

In this time of necessity to improve teachers' competence in teaching science and technology, the application of resource-based learning is a promising initiative. It is high time that educators must explore other alternative means of instructional delivery to address problems on classroom instruction. With the current constraint in time and preparation of instructional materials, it is practical and wise to develop an instructional material that can be used by teachers as a guide in teaching. A course guide that is grounded on the principles and features of resource-based learning may be useful.

With the recent environmental concerns that inevitably affect educational achievement, the academe can be an important tool in promoting awareness. In everyday lesson in all areas of learning, a teacher must find ways on how the environmental concepts be integrated to promote awareness and encourage young people to take part in solving the problems brought about by the current and alarming issue. Chemistry is one subject that a teacher may integrate environmental concepts as part of an initiative in mitigating the impacts of climate change.

This study is in response to the important role of teachers as agent of the learning process, current environmental issue that affects educational ecology, as well as the critical scenario being faced by chemistry education. It developed and validated an appropriate course guide in teaching college chemistry grounded on the principles of resource-based learning, integrated with basic environmental concepts and determined its effect to achievement level of students.

The developed course guide covers all the chemistry topics included in a three (3) unit General Inorganic Chemistry class. It is composed of lessons that serve as an instructional material for chemistry teachers. The lessons covered all topics in a General Inorganic Chemistry course. It featured an introduction, objectives, content, integration of values and environmental concern, teaching strategies, learning activities, assessment method and learning resources. It was tried out to an experimental class and submitted for evaluation by educators who were experts in the field of chemistry education.

Review of Related Literature

Education is at the very core of basic issues that confront human society. It plays an important role in all societal concerns and thus greatly affects the future of the people. All educators have a tremendous responsibility to contribute something to the difficult but necessary effort of developing philosophy of education suited to our needs but at the same time worthy of the broad purposes of human development. One way to resolve this concern is to adopt teaching approaches and develop instructional materials that continuously evolved and respond to the needs of the changing times. These approaches and instructional materials must be able to provide quality instruction and also address global problems in Chemistry education. Learning theories and principles laid the foundation of instructional strategies being introduced in the academic world.

Teachers are encouraged to confront students with problems and help them to seek solutions either independently or by engaging in group discussion. (Gines *et al*., 1996). Ausubel pointed out in his Theory of Social Learning that, the learner's existing structure of knowledge defines the conditions, determinants, and outcomes involved in the acquisition of new knowledge.

Constructivist learning has emerged as a prominent approach to teaching. It represents a paradigm shift from education based on behaviorism to education based on cognitive theory. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on cognitive structure. Cognitive structure provides meaning and organization to experiences and allows the individual to go beyond the information given. Constructionism builds on the constructivist theory asserting that knowledge is not simply transmitted from teacher to student but is actively constructed

in the mind of the learners. Constructivist Theory laid the foundation of Resource-Based Learning.

Instructional Aid Theory recognizes the important role of instructional materials to learning. It states that during the communicative process, the sensory register of the memory acts as filter. As stimuli are received, the individual's sensory register works to sort out important bits of information from the routine or less significant bits. The complex process is enhanced by the use of appropriate instructional aids that highlight and emphasize the main points or concepts.

Resource-Based learning is a philosophy of education and a methodology for teaching and learning. It involves the achievement of both subject and information literacy objectives through exposure to and practice with diverse resources. Students become active learners as they use a wide range of materials to investigate subject material prescribed within their classroom curriculum (Brown *et al*.,1996) [3].

Resource-Based Learning is a view that gives prominence to the role of resources in the teaching and learning process. It conceptualizes learning as a process which foregrounds the importance of the resources available to learners as the main structuring device of the learning situation. Availability of resources allow learners to choose their own learning path while providing them with supportive structures (Esch and Zahner, 2000) [5].

Resource-Based Learning is more engaging and therefore more motivating thus make students better learners. It employs the Turner and Paris six strategies for motivation (choice, challenge, control, collaboration, constructing meaning and consequences) and provides the training ground for development of the necessary information literacy skills for learners to navigate the changing, sometimes confusing landscape of information sources

In RBL, the teachers act as coaches, facilitators or guide as their learners are sampling and manipulating information in multiple formats. The teaching of facts is replaced by teaching students how to learn. The goal is to teach students to find, evaluate and use information to tackle the challenges they encounter in the learning process. Learners take responsibility for selecting resources that appeal to their own learning preferences, interest and abilities. When the constructivist educator uses resource-based learning, instruction is teacher planned but student- centered.

An integral aspect of RBL is its flexibility. Students may work alone, or cooperatively. They select resources which fit best with their learning styles. The benefits of resource-based learning also include maximizing the use of instructional resources and teaching time as well as effective incorporation of technology into the curriculum. Higher education providers are increasingly turning to resource-based learning as a means of coping with the conflicting demands to produce even higher standards of curriculum delivery.

Instructional materials play a key role in the changes that move toward inquiry- centered standards-based instruction. It influences student achievement, use of process skills and other instructional outcomes. It provides the physical media through which the intent of the curriculum are experienced. Instructional aids are devices that assist an instructor in the teaching-learning process. It supports, supplement, or reinforce. Instructors or teachers may become involved in the selection and preparation of these materials.

A variety of instructional materials in chemistry teaching have been developed by researchers and faculty for Chemistry Education. Most of them are in the form of workbooks, handouts, tutorial lessons and the like. Every country in the world is now realizing the important role of instructional materials to quality education.

Instructional materials are indispensable tool to the teaching-learning process. It shall support the Department of Education's instructional goals and standards taking into consideration the varied instructional needs, interests and maturity levels as well as data and demographics of the students to be served; must stimulate students' growth in conceptual thinking, factual knowledge, aesthetic values and the development of ethical standards; should be of sufficient variety so as to represent various views of issues in order that young citizens may develop skills of critical analysis and informed decision making; and shall contribute to the development of an understanding of the ethnic, cultural, and occupational diversity.

With the knowledge about instructional materials development, a teacher can successfully develop an appropriate and relevant instructional material to be used in teaching a particular subject. In General Inorganic chemistry, because of some problems on fiscal and material resources, a chemistry teacher can devise a course-guide grounded on the principles of Resource-Based Learning which is based on existing material resources. A Course guide in chemistry teaching helps a teacher carry out a learning experience within the domains of the intent of the chemistry curriculum.

Studies reviewed revealed that efforts are exerted to better off student achievement. Chemistry education is one of the major concerns and a number of studies had been conducted to improve chemistry achievement. Factors such as teaching approach, misconceptions in chemistry, special project component, laboratory exercises, student perspectives, are some of those that were investigated. Studies on the use of resources were mostly focused on the use of online sources and technology and none was directly linked to chemistry instruction.

Instructional development is also one of the major themes of studies. There were those that developed and validated modules in specific learning areas, instructional materials intended for certain kind of learners such as those with learning disabilities, instructional aids that were anchored on certain learning theory, and development and validation of workbooks and laboratory manuals for specific science classes. No study however was noted on the development and validation of a course guide for chemistry teaching, and there was not a single study to effect better achievement in chemistry that was grounded or inspired by resource-based learning. There was also no instructional material developed that was integrated with environmental concepts, this is the gap that the study bridged.

Theoretical and Conceptual Framework

Constructivist Theory, Social Learning Theory and Instructional Aid Theory laid the foundation in the development and validation of the resource-based course guide in General Inorganic Chemistry as shown in figure 1. The principles of resource-based learning further enhance the researcher's competence in developing an appropriate and effective instructional material that can aid chemistry teachers in teaching the subject.

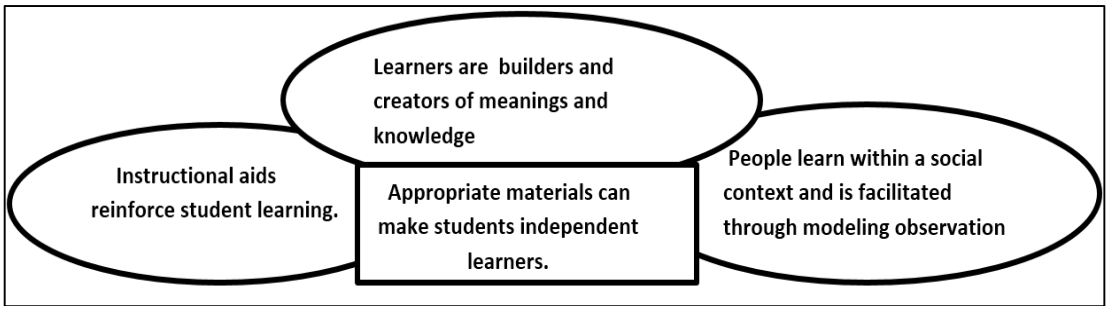

Fig 1: Theoretical Framework

Through resource-based learning, students develop the skills necessary for gaining access to information, acquiring knowledge and understanding, and the ability to use learning resources for personal growth and fulfillment. A chemistry learning program that uses strategies linked with resource-based learning will surely promote chemistry conceptual understanding. The variety of learning resources encountered by the learners in Resource-Based Learning Environment (RBLE) likewise aids them as they construct knowledge.

The illustration in figure 2 conveys that the Resource-Based Course Guide in Teaching General Inorganic Chemistry Integrated with Environmental Concepts developed by this study can enhance learning in General Inorganic Chemistry course.

The features included in the Resource-Based Course Guide such as general introduction; eighteen lessons; activity/experiment guide and appendices was conceived to enhance conceptual understanding, thinking and laboratory skills development; and values development. Every lesson that includes a lesson introduction, objectives, chemistry and relevant environmental science concepts, integration of values and environmental concern; assessment; assignment; and learning resources will serve as the teachers' guide in preparing for their daily lesson. The learning environment that will be created as the teacher adopts the suggested instructional strategies will result to enhanced learning of chemistry concepts.

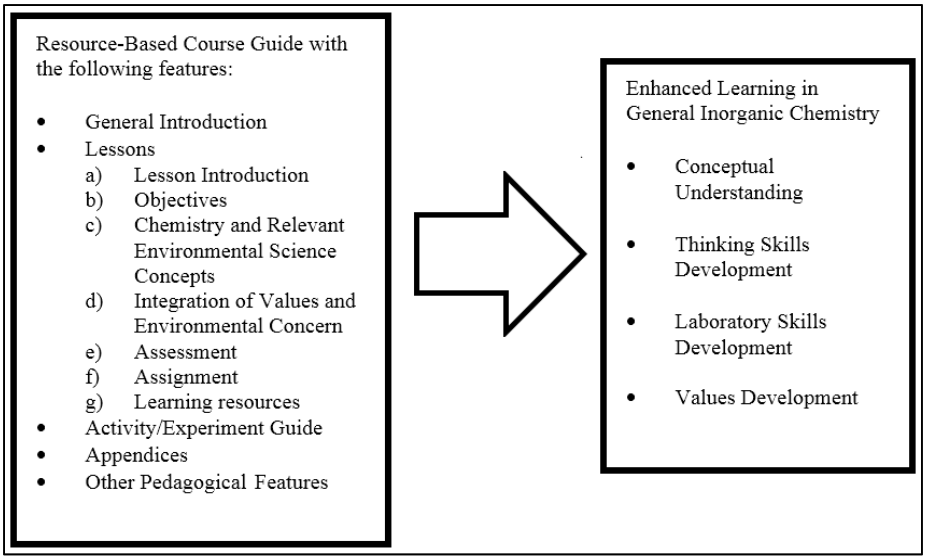

Fig 2: Conceptual Framework

Methodology

Methodology was composed of two major parts: part I was the development of the course guide and part II was on the validation of the developed instructional material. Part I includes development of a framework or format of the course guide, review of reference materials, organization and writing and printing of the final draft.

Validation includes evaluation by experts using a constructed Course Guide Evaluation Instrument (CGEI) and tryout of the material to a class in General Inorganic Chemistry. Quasi experimental method was used in the study utilizing one group design. Students in the experimental class were taught based on the instructional strategies and activities suggested in the developed course guide. Effect of the intervention was measured in terms of the conceptual understanding, thinking skills and laboratory skills development of the students.

Pretest and posttest were administered using the teacher made achievement test focused on conceptual understanding and thinking skills to determine the effect of the developed course guide to the achievement level of students in chemistry. The laboratory skills development was measured through a practical test which was given before and after the intervention. Values development was determined from the evaluation of the essay assigned to the students and their answers to the essay questions given to determine awareness and concern for the environment. Rating scale used was developed from on Krathwohl's Taxonomy of Affective domains.

The statistical methods used to analyze quantitative data gathered were the mean, standard deviation, and t-test.

Significant Findings

A. Resource-Based Course Guide and Its Features

The Resource-Based Course Guide was designed to be used by chemistry teachers to ease their academic function because it will provide a ready reference for lessons and activities that are needed in the preparation of the their daily lesson plan. It was composed of a general introduction; eighteen lessons covering all the topics for a three (3) unit one semester General Inorganic Chemistry course; activity guides; and appendices. The parts are intended to cater to the instructional needs of chemistry teachers for them to achieve success in lesson delivery. Box that follow gives a sample lesson guide.

BOX 1: Sample Lesson Guide

Lesson Guide 1

Nature and Scope of Chemistry

The lesson focuses on the introductory concepts of chemistry. It is expected to open the students' mind towards the scientific and significant world of this branch of science. Discussions include the nature and scope, history and impact of chemistry to mankind to make the learners realize its role in their lives.

I- Objectives

At the end of the learning sessions, the learners are expected to:

1. define chemistry;
2. describe the nature and scope of chemistry;
3. trace how chemistry emerged as a branch of science;
4. enumerate impacts of chemistry to society particularly its role in responding to the issues and problems on climate change; and
5. identify common laboratory apparatus and associate these with things and activities in the environment.

II- Content

A. Topics:

1. Nature and Scope of Chemistry
2. History of Chemistry
3. Impact of Chemistry
4. Common Laboratory Apparatus

B. References

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Benefits of Chemistry. Retrieved from http://www.chemistryclassroom.com

C. Time Allocation: 5 hours: 1 lec session, 1 lab

D. Concepts

The following are pertinent concepts that should be learned by the students:

1. Chemistry is the study of matter. Its properties and characteristics, composition, structure, changes as well as the laws and principles that govern the changes. It is a physical science that study various atoms, molecules, crystals and other aggregates of matter whether in isolation or in combination.
2. Chemistry as a science promotes scientific skills and attitudes through the use of scientific method. Scientific method is a set of procedures used to acquire information, knowledge and explanations of certain phenomena. It is composed of pertinent steps such as: problem identification; formulation of hypothesis; data gathering; experimentation and generalization of formulation of laws and theories. Laboratory apparatuses are used to carry out scientific processes.
3. Chemistry was believed to have emerged from the Greeks who were noted to make logical speculations about the physical world rather than relying on myth to explain phenomenon. Alchemy, the art of transmutation of matter was the major president of its, which was later followed by more scientific efforts in the study of materials world.
4. Chemical technology is the application of chemistry concepts and principles to a particular purpose it comes in the form of a new substance, a new product, a new process and new materials. Chemistry had been an important part of every technology because it is the foundation of all sciences. The study of plants and animals in biology would not be that deep without understanding these materials at the molecular level. The knowledge about the composition, physical and chemical nature of plants and animal systems lead into the determination of its functions and applicability to human lives.
5. Recently with the increasing environmental concerns brought about by climate change disasters, chemistry has been playing an important role in restoring quality of important resources such as water, soil and plant products. Environmental chemists are key persons that conduct water and soil analyses to determine the extent of damaged to these natural resources and also suggest method and procedures to be able to restore it to consumable state. Evidently chemistry is also a key science involved in proper waste management. With its understanding about the properties of materials, chemistry can effectively suggests ways on how to properly segregate and re-use waste products.
6. Chemistry as a branch of science involved laboratory investigations. During a laboratory process, learners are required to

use apparatus and materials to carry out scientific work. Common Laboratory apparatus includes beaker, test tubes, graduated cylinder, erlenmeyer flasks, florence flasks, tripod, alcohol lamp, watch glass, mortar and pestle, thermometer, weighing balance and many more. Each of these apparatus are performing specific function to help learners in carrying out laboratory procedures and promote safety in the laboratory.

E. Skills to be developed

The following are the skills to be developed by the learners after the learning session:

1. defining chemistry
2. describing the nature and scope of chemistry
3. recording the emergence of chemistry as a science through a timeline;
4. describing the impact of chemistry to mankind
5. identifying laboratory apparatus; and
6. describing the functions of laboratory apparatus and associating it with things and activities in the environment

F. Values Integration

Show a power point presentation on the Science of Climate Change, a copy of the presentation is available on the CD that comes with this course guide. After the presentation ask the question: "With the recently increasing environmental concerns brought about by climate change disasters, how will you help promote environmental awareness and conservation?" to start the brainstorming on the issue.

III- Instructional Strategy

A. Motivation

Ask the question: "How will you compare and contrast life in the early times to your life in these times of technology?

B. Lesson Proper

Employ a Small Group Discussion for the topic nature and scope; and history of chemistry by grouping the class into 5 with 5 to 6 members. Using print and online resources such as books, journals, downloaded materials and internet, require the groups to prepare a concept summary and timeline in a manila paper to be shared to the class after 30 minutes. Each group must be given 10 minutes for the presentation and give a summary lecture (Brainstorming) to verify the concepts presented by students and correct misconceptions.

Impart the impact of chemistry through Consequence Mapping by group. Assign each group with an area of human need to define the focus of their output, it may be a choice of: food production, health and sanitation, transportation and communication, education, sports and recreation and medicine. Final output of the groups will be a consequence map that reflects the group's idea on the positive and negative effects of chemical technology to mankind. Show the concept maps to the class for critiquing and brainstorming, which you can follow with the power point presentation on the Science of Climate Change.

Let students do a Laboratory investigation to introduce common science processes and develop laboratory skills and values. Laboratory and activity guides are attached to guide you in instruction.

IV- Assessment

Require a poster making on the evolution and impact of chemistry to the society as an assessment method. Evaluate the output using a rubric.

V- Assignment

1. Describe how chemistry emerged as a branch of science. Cite other benefits that you can get from chemical technology.
2. How will you relate measurement to scientific processes and procedures?
3. Describe System International. What are units used in this system of measurement?
4. How important is scientific notation in recording and processing data in science

The lessons give instructional strategy for lesson delivery to give chemistry teachers an idea on how they will create an environment that allows maximum learning of chemistry concepts. Every lesson includes the objectives of the lesson, specific topics to be covered, references/resources of the concepts to be learned, skills to be developed, integration of values and environmental concern, strategy for lesson delivery, assessment technique, and assignment. Next to the lesson guide are activity guides and exercises needed in the execution of the lesson described to help teachers carry out the lesson successfully. Features of the Resource-Based Course Guide in Teaching Inorganic Chemistry makes it relevant and effective in teaching the subject.

B. Evaluation of the Resource-Based Course Guide by Jurors

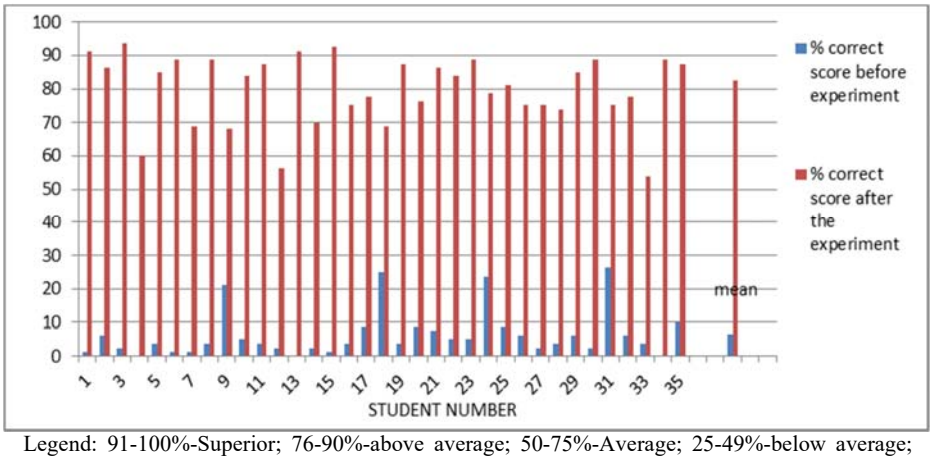
Results of the study showed that the resource-based course guide is very good and acceptable. Juror's evaluation revealed that it is very good in terms of content, pedagogical and technical aspects. The mean rating of 3.94 for content component given by expert evaluators indicated that the concepts presented were enough for the learners to acquire the necessary competencies on the topics. The evaluation further implied that experts had noted the completeness, correctness, suitability and clarity of presentation of the concepts in most of the lessons. The grand mean rating of 4.19 for pedagogical component indicated that the objectives are complete and appropriate; strategies suggested for the lessons are appropriate to the topic, upholds learning theories, can enhance students' interest, supports critical and creative thinking, promotes independent and discovery learning, and are realistic and friendly to both teachers and students; capacity of the learners was considered and integration of values and environmental concern was likewise manifested in the lessons; and assessments were acceptable. The technical aspects were generally acceptable as indicated by the grand

mean rating of 4.06. Result showed that the entries in the developed course guide for teaching General Inorganic Chemistry is valid and acceptable as far as organization, uniformity of parts, presentation, relevance of features, sequencing of activities and exercises and correctness of entries are concerned.

C. Effectiveness of the Resource-Based Course Guide in Improving Achievement Level of Students in General Inorganic Chemistry

Results showed that the developed material is effective in improving achievement level of students in General Inorganic Chemistry. Achievement test results further reflected that students gain better conceptual understanding and their thinking skills were developed.

The achievement test mean of the experimental class during the pretest is 5.79 indicated a low level achievement. After the intervention, increase in the mean was noted and the t-value of 9.92 indicated that the intervention had caused the significant difference in the mean scores. It can be inferred that the teaching-learning methods suggested in the developed course guide had positively affected the achievement of the students. Further analysis of the achievement test results as shown in figure 3, revealed that from generally poor in chemistry content at the start of the study, it was significantly changed to above average after the intervention.



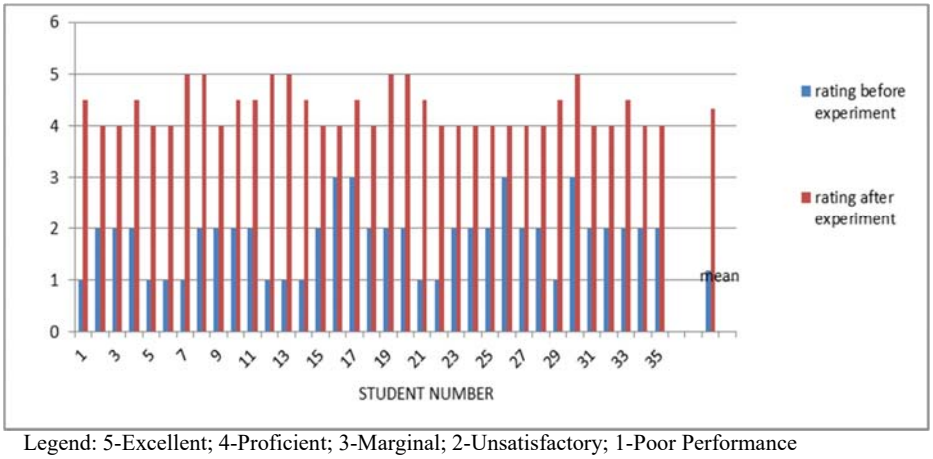
Legend: 91-100%-Superior; 76-90%-above average; 50-75%-Average; 25-49%-below average; below 25%-poor

Fig 3: Achievement Level of Students Before and After the Experiment

The mean of the pretest for conceptual understanding was 4.19 which was increased to 49.59 in the posttest. T-test for correlated samples of 31.96 at 0.05 level of the significance, revealed a significant difference between the two mean scores. Results implied a significant effect on the development of conceptual understanding of the student due to the learning modalities suggested in the developed course guide. It was specifically noted that the highest mean increase of 5.14 was achieved by the learners on chemical reactions and equations and the lowest was 1.98 on stoichiometry.

The mean of the students in the test for thinking skills was 1.60 and it was increased to 14.09 after the intervention. The significant difference in the mean of the pretest and posttest of the students as indicated by the t value of 23.89 is a proof of thinking skills development. Results further revealed that the students gained a positive mean difference in all of the specified thinking skills that includes principle formation, decision making, comprehension and problem solving. This was backed up by the noted capacity of the learners to answer correctly the essay questions given to further determine thinking skills development of students in the experimental class.

The mean rating obtained by the experimental class in the practical test given at the start of the study as shown in figure 4 was 1.83 corresponding to unsatisfactory skills. After the intervention, the mean rating becomes 4.32 indicating an excellent or very high skills development. The students were likewise observed to show confidence in manipulating the materials and carrying out the procedure during the conduct of the practical test.



Legend: 5-Excellent; 4-Proficient; 3-Marginal; 2-Unsatisfactory; 1-Poor Performance

Fig 4: Laboratory Skills of the Students before and After the Experiment

Values development of the students particularly on environmental awareness and concern as shown in the scores gained in the assigned essay and answers to the essay questions indicated that students in the experimental class had achieved a remarkable level of awareness and values development. Evaluation revealed that 37% or 13 students are already acting on the issue, 60% or 21 students are responding and barely 2.86% or 1 student was found receiving.

D. Comments and Suggestions to Improve the Resource-Based Course Guide

Suggestions to improve the resource-based course guide were on format revision; review of certain parts particularly of the objectives, skill to be developed, and integration of values and environmental concern; review of materials used in laboratory activities; statement of procedures and guide questions; and consistency of format.

Recommendations

The developed resource-based course guide in teaching general inorganic chemistry may be recommended for teachers' to be able to provide their students with a friendly, student-centered learning environment. They must be guided by the principles of resource-based learning in implementing the activities suggested. Studies on the development of resource-based course guide in teaching other chemistry subjects is a worthy initiative to further come up with instructional material that will better off chemistry education and promote science culture. The advocacy to promote resource-based learning should be enhanced to develop authentic learning on the part of the learners.

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