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Original Research Article

Outcomes-Based Learning Guides in Electricity and Magnetism Using Constructivism

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Abstract

This study aimed to develop an outcomes-based learning guide in Electricity and Magnetism using constructivism. One-shot pretest-posttest experimental design was used with 24 students. The learning guide was rated as "very highly attainable" in terms of learning outcomes, "very highly valid" in terms of content, "outstanding" in terms of structure and organization, and "very highly appropriate" in terms of both learning and evaluative activities. Overall, the learning guide has "very high validity." The students progressed from a "poor" performance to a "very good" performance. Post-attitude level is statistically higher than pre-attitude level. The learning guide is highly recommended for use as a physics instructional material.

Keywords: Constructivism, electricity and magnetism, outcomes-based education

INTRODUCTION

Science Education plays a major role in creating a global knowledge society. It is essential in developing creative and critical thinking. Basic science literacy, coupled with scientific ways of knowing from drawing conclusions based on observations, experiment and analysis, provides citizens with the tools needed for making sound decision (ICSU, 2011). The development of instruction is the main goal of science education. Teachers play an important role in the implementation of national policy to develop students' potential. Multitalented and multi-skilled teachers are needed in science teaching. Innovative, creative and resourceful teachers are needed for globalization.

It has been noted that in the 2003 TIMMS or Trends in International Mathematics and Science Study in the Philippines, Filipino students performed poorly in both mathematics and science as compared to students from other nations. According to the report, the Philippines ranked seventh among the nine Southeast Asian nations in the area of education and innovation. In terms of global competitiveness in the areas of education, science, technology and innovation as measured by the World Economic Forum, the Philippines was reported to be better than Cambodia, but inferior compared with the six other South East Asian countries, namely, Singapore, Brunei, Malaysia, Indonesia, Thailand and Vietnam. This is one of the reasons why the education sector of the Philippine government has to make a major change in the basic curriculum to improve science education.

Science education in the Philippines has been continuously revised to answer to the demands of time. Upgrading the quality of science education remains as one of the thrusts of the Department of Education and the Commission on Higher Education. Reports have shown that accomplishments of a few students are overshadowed by the consistently poor performance of Filipino students in the international and national assessment studies. Studies reveal that Filipino students have low retention, have limited reasoning and analytical skills and cannot even express ideas or explanation of events in their own words. (UPNISMED, 2004). A large percentage of Grade 6 and Fourth Year (Grade 10) students in selected schools cannot apply concepts in real life problem solving solutions nor design an investi-

gation to solve a problem (UPNISMED, 2005).

To improve every aspect of the quality of education, the government has started the implementation of the Kindergarten to Grade 12 Basic Education Program or the K to 12 Curriculum in 2012. In school year 2017-2018, the first batch of this program will be entering Grade 10. As stated in the Science Framework for Philippine Basic Education published in 2011 by the Department of Science and Technology-Science Education Institute, University of the Philippines and the National Institute of Science and Mathematics Education, science curriculum envisions the development of scientifically, technologically and environmentally literate and productive members of the society. This framework is geared towards the acquisition of lifelong learning skills as well as scientific values and attitudes.

The goal of science education specifically physics education is to achieve better learning outcomes by the students. Outcomes Based Education has been introduced in the in the educational reform. This teaching and learning innovation in the Philippine educational system aims to equip learners of 21st century skills and develop them holistically. In the past few years, the Philippines initiated a major curriculum revision on the implementation of the enhanced basic education curriculum (K to 12) in 2013. The new curriculum aims to produce critical problem solvers, innovative and creative citizens, informed decision makers and effective communicators. Outcomes Based Education develops among students lifelong learning to make them useful citizens in a competitive world.

Education aims to provide learnings and knowledge, also to enhance the skills and abilities of every student, to bring competence, and guide them with positive attitude and values. Quality education considered as an important factor to produce competent professionals in order to build a strong nation and to bring out the best way to get along with global competition. Education is facing challenges in terms of worldwide movement of international students mostly from the Asian and African continents to universities in the West to provide an important source of income to those receiving universities (Biggs & Tang, 2010).

The science curriculum framework for basic education is also focused on the improvement of teaching and learning process and learning environment that promotes the construction of ideas. This current reform effort is also associated with the notion of constructivism.

To improve instruction, upgrading of school and laboratory facilities is done to fit in the creative minds of students. Conduct of intervention programs and implementation of innovative teaching strategies is used to uplift science education. Measurable learning outcomes are achieved by scientific literacy. The training of science teachers is conducted every summer or every end of school year to enhance their skills. Teachers are trained to teach students to become more creative and constructive, to make science learning interesting and to make the learning environment exciting. Students are generally interested in problems that puzzle them. They have the natural urge to find solutions. Hands-on learning activities that develop the interest of the students to become active learners should be emphasized. According to the National Science Teachers Association or NSTA, science instruction should incorporate a variety of instructional practices based on constructivist theoretical framework to meet science standards (NSTA Position Statement: Leadership in Science education, 2011).

The Department of Education and Commission on Higher Education have been spending time and effort in the curricular reforms of the Philippine educational system. Outcomes-based education has been introduced and now being practiced by some premier schools in the country. Outcomes-Based Education focuses more on the results of the subject matter than just being able to impart knowledge in the students taking them. The Technological Institute of the Philippines, in 2011, aligned their curricula with the initial desire of the Philippine Higher Education Institutions (PHEIs) and their own Engineering programs to qualify under the Washington Accord, which is an international accreditation agreement for professional engineering academic degrees since 1989.

The Commission on Higher Education (CHED) Memorandum Order 46 s. 2012, called “Policy Standards to Enhance Quality Assurance in Philippine Higher Education through an Outcomes-Based and Typology-Based Quality Assurance,” was the birth child of CHED’s OBE initiatives. The order ultimately came from a series of conferences between Higher Education Institutions (HEIs) and CHED, changing the focus of modern Philippine education from input-based to output-based. The CHED Memorandum Order encompasses what is now known as the Outcomes-Based Education system that is being applied nationwide. As the term implies, the OBE focuses more on the outcomes of learning. Examples are competencies acquired and developed by students and how these things become concrete and measurable to be applied in the future. In planning the learning experiences of the students under OBE, teachers now create their class syllabi with the end in mind.

With these educational reforms, Outcomes-Based Learning, therefore should be inculcated in the minds of curriculum reviewers. What matters ultimately is not what is taught but what is learned. Course intended outcomes are set appropriately instead of teaching objectives. Course syllabi should be aligned on how teachers teach with the intended learning outcomes and that they should be fully consistent with each other. The quality of teaching is evaluated by the quality of learning. Outcomes-Based Education is criterion based view of assessment and it is focused on what the students can

do with the knowledge after a period of learning.

Constructivist teaching approaches have been introduced in the country in the late 90's to ensure better learning outcomes. Educational researches have been conducted to determine the views on science learning. In a recent study conducted by M.P. Obrero and M.M. Obrero revealed that teachers agree on the constructivist view on science learning. Student-centered constructivist approach has also been proven to be appropriate for college physics teaching. Students can interact better with their classmates and teacher in a constructivist classroom than in a traditional classroom (Obrero, 2016). Barak and Shakman (2007) also contrasted a constructivist instructional practice framework with a traditional approach. In the constructivist framework the instructor shares decision making, teaches students how to analyze their own thinking. In contrast educators from a traditional framework make the classroom decisions and focus on learning facts and principles. In the constructivist framework, learning is viewed as an active process of constructing meanings linking new information with experience.

Physics being tagged as a difficult subject is shown in the performance of the Filipino students in various international assessments. No subject in the curriculum today has drawn greater attention than science (Tabago, 2011). Considering the worth of knowing physics, it becomes a challenge for teachers how they could make physics teaching more interesting to the students. Students' misconceptions in science, specifically in physics are common and universal in scope. After conducting an extensive review of literature, the researcher found out that one of the approaches or strategies in teaching which takes into consideration the misconceptions of the students is the constructivist approach. According to Novodvorsky, constructivism is a philosophy of learning that covers all classroom activities, thus, it is also applicable in the performance of experiments in the laboratory.

It is noted however that some teachers have difficulty in teaching due to lack of teaching and learning guides. They rely on the use of recipe type laboratory manuals which do not develop the creative skills of the learners. To solve this problem, the researcher was encouraged to develop a learning material that will facilitate teachers in teaching physics, the constructivist learning guide in physics. This learning guide will help students bring out their creativity through project making, which develops their communication skills through oral and written reports or presentation. Students will be given the chance to discuss with their groups, and present their observations and reflections in journals.

The constructivist approach was utilized in this study. It is the researcher's desire to test the effectiveness of the constructivist approach-based experiments in teaching and learning selected physics concepts. The results of this research are important to curriculum planners, teachers, future researchers and most of all student learners. To the curriculum planners, the Outcomes-Based Learning Guide (OBLG) will help them evaluate the performance of the students in a specific topic. The learning guide can also be utilized by teachers who will be teaching General Physics 2. This will facilitate them in their activities in teaching physics. For the students, this is useful especially for the incoming Grade 12 students in Science, Technology, Engineering, and Mathematics or STEM. These students will be taking up General Physics 1 in the First Semester and General Physics 2 in the Second Semester. The use of this OBLG in Physics will develop their creative minds and abilities to express knowledge through a variety of ways. In addition, the use of this OBLG will more retain the transfer of new knowledge to real life. To the administrators, this may serve as a basis for policy making in the improvement of instruction in the institution. The results of this research will be useful to other researchers in conducting researches for the improvement of teaching and learning and science education. The use of the constructivism in the OBLG can possibly uplift the quality of science education, and, thus, widen the possibility of making Filipino learners globally competitive.

The challenge now for physics educators is to be more creative and innovative. Thus, the development of a learning guide for students was conducted. This Outcomes-Based Learning Guide helps them develop their critical thinking skills and creative minds.

Framework of the Study

Outcomes Based Education and Constructivism are relevant to the present study. These are the bases for the formulation of the conceptual framework of the study.

Outcomes- Based Education

Outcomes- Based Education is an educational framework which is focused on what is essential for all students to be able to do successfully at the end of a learning experience. It is about preparing students for life, not simply getting them ready for college or employment. The Commission on Higher Education (CHEd) strongly advocates a shift from a teaching or instruction-centered curriculum to a learner or student-centered curriculum. This is a shift from input oriented to outcomes based education in which the learning outcomes are developed (Castillo, 2013). In OBE, students are made aware of what they ought to know, understand and what they are able to do after completing a unit of the course. Outcomes-based teaching and learning (OBTL) is a constructive alignment of intended learning outcomes with appropriate outcomes-based assessment methods

and teaching and learning activities. In 1990, Outcomes-Based Education (OBE) was popularized by William Spady a model of education that makes students demonstrate what they know, and what they are able to do as a result of education. In OBE, what ultimately matters are not what is taught but what is learned. If the students have not learned, the teacher has not taught (Vicencio). Innovation is therefore encouraged.

Outcomes-based education is a model that rejects the traditional focus on what the school provides to students, in favor of making students demonstrate what they "know and are able to do" whatever the required outcomes are (Santiago, 2011). The OBE transformation emphasizes setting clear standards for observable and measurable outcomes. This system can be judged by the following attributes: a) creation of a curriculum framework that outlines specific, measurable outcomes. The standards included in the frameworks are usually chosen through the area's normal political process; b) a commitment not only to provide an opportunity of education, but to require learning outcomes for advancement. Promotion to the next level, a degree, or other reward is granted upon achievement of the standards, while extra classes, repeating the year or other consequences entail upon those who do not meet the standards; c) standards-based assessments that determine whether students have achieved the stated standard assessments may take any form, so long as the assessments actually measure whether the student knows the required information or can perform the required task; d) a commitment that all students of all groups will ultimately reach the same minimum standards. Institution may not give up on unsuccessful students. The emphasis in an OBE education system is on measured outcomes rather than inputs. Outcomes usually require a range of skills and knowledge, and outcomes of learning are expected to be quantifiable.

In the study of Aldrich (2007), an instrument was developed to assess students' perceptions of their learning environment as means of monitoring and guiding changes towards outcomes-based education. The study showed significant contributions to the field of learning environments and that it captures important aspects of learning environment associated with outcomes-based education.

Outcomes-Based Education applied inside and outside the classroom with appropriate outcomes based assessment method and teaching and learning activities is relevant for building capability for students. It is an explicit statement of what students aim to achieve. It also provides framework for education for Basic as well as higher education. OBE is an explicit statement of what the curriculum is setting out to achieve. It facilitates quality assurance process. OBE is self-directed learning. Students are clear about what they are doing. They can take more responsibility of their own learning. It promotes student-centered approach and is flexible. It does not specify a teaching strategy or a method. It employs variable methods. What is important is students achieve the outcomes. OBE is a guide for assessment and it is the outcomes that are assessed not the teaching or the teacher.

According to the Hongkong Institute of Learning, Outcomes Based Learning is a student cantered strategy that keeps student learning at the center of the teaching-learning process. The key purpose of outcomes based learning is to assist students in attaining learning outcomes that would enable them to be competent professionals, active and caring citizens.

Center of Development of Teaching and Learning stresses that OBE provides high level of learning for all students as it facilitates the achievement of the outcomes, characterized by its appropriateness to each learners' development level and active and experienced based learning (Chadrama, 2003).

As mentioned in the study of Closon (1993), the role of the teacher in the classroom is to serve as coach. The teacher aims to push students towards the attainment of pre-determined outcomes, and not to simply transmit knowledge to the students viewed as passive learners. There ought to be a change in the teacher's role because outcomes-based education does not emphasize content. Instead, it focuses on students' attitudes, feelings, and skills such as ability to work with other students. Students must be prepared for future employment, and the constant change that inevitably happens in the society.

According to Caguimbal, Delacion, Medina, M. Mendoza, R. Mendoza & Sanchez (2013), the importance of identifying the outcomes or the result that the students have to acquire after each lesson should be defined. He stressed further in his study that a well-defined assessment criterion should be clear to both facilitators and learners how assessment should take place. He stressed further that in constructing a learning material on Outcomes- Based Education may require great time and effort on the part of the teacher but it ensures lifelong learning on the part of the students.

Pedrola (2016) conducted a study on the Teacher Education Programs of SUCs in Region I and proposed an Outcomes-Based Curriculum Model. This study motivated also the writer to develop an Outcomes-Based Learning Guide which will be useful to the Senior High School Curriculum particularly the strand on Science, Technology, Engineering and Mathematics or STEM. Since in the new curriculum guide for STEM in Grade 12, Physics 2 is taken up by the incoming Grade 12 students.

Constructivism

The constructivist learning theory has gained the interest of educational researchers during the past few decades. Investigations on its implications to various fields and

levels of education have been undertaken. Findings in various researches suggest that constructivist-based teaching methods ensure better outcomes of the teaching and learning process. The importance of researches on physics education have proven the effectiveness of constructivist approaches in yielding higher achievement of students. In a constructivist learning environment, each student actively constructs knowledge, develops skills and integrates values. This kind of environment promotes reflective thinking, respecting others' ideas, having an independent opinion, skillful problem solving, collaborative work, responsibility for one's conceptions, and community involvement (Jucevičienė and Karenauskaitė, 2004).

Constructivism evolved from earlier theories. The works of Kant, Piaget, Vygotsky, and Dewey served as the theoretical bases of the constructivist model. Kant's theory of a priori knowledge proposes that a person experiences the material world through sense perception (Hendry, 1996). Piaget's theory of genetic epistemology stresses that a learner constructs knowledge through his interaction with the environment (Hendry & King, 1994). Likewise, Vygotsky's theory emphasizes the social dimension of learning (Alexopoulou& Driver, 1996) while Dewey's model proposes that the continuous process of education is aided by experience and inquiry (Hendry, 1996).

Bruner developed a theory on constructivism which suggests that learning is an active process of forming new ideas based on authentic experiences. According to his model, there are three stages of representation. These are the inactive stage in which knowledge comes in the form of motor responses, the iconic stage in which the knowledge is converted to visual images, and finally, the symbolic stage in which the knowledge is now in the form of words and symbols (Cherry, 2004).

Constructivism gained attention for it advocates learner-centered approach and active participation among students. According to Gulbahar (2006), in classes where constructivist approaches are implemented, students have a chance of learning by doing, enhancing their critical skills, and shaping their learning process by being active participants. Project-based learning is one of the methods grounded in constructivism. Students in a project-based learning environment deal with real life problems, which may result in permanent knowledge.

The constructivist approach to science has been shown by several studies, mostly doctoral dissertations, to be more effective and productive than traditional methods. The new methods and approaches have also been found to result in favorable attitudes of students toward science but it has not been easy to get science teachers in general to accept the validated approaches.

Physics teaching and learning is more significant if it is coupled with experiments. Constructivism in teaching physics will aid in elaborating the subject matter. Teachers will be able to guide the students very well in the laboratories. On the part of the students, constructivism gives students ownership of what they learn since learning is based on students' questions and explorations, and often the students have a hand in designing the assessments as well. Constructivist assessment engages the students' initiatives and personal investments in their journals, research reports, physical models, and artistic representations. Constructivism is one of theory of learning which is recently well developed and has become most significant and dominant perspective in science education (Taber, 2006). Constructivist model focuses on constructing the knowledge in the learners' mind. Every student has different experiences, therefore, teachers have to be aware that knowledge is constructed differently in the learners' minds. Students have their own preexisting knowledge based on their experiences that is constructed in their minds (Taber, 2006). Most studies show the advantages of using this theory of knowledge in the learning process for it recognizes students' alternative conceptions.

Constructivism is a learning strategy that draws on students' existing knowledge, beliefs, and skills. With a constructivist approach, students synthesize new understanding from prior learning and new information. The constructivist teacher sets up problems and monitors student exploration, guides student inquiry, and promotes new patterns of thinking. Working mostly with raw data, primary sources, and interactive material, constructivist teaching asks students to work with their own data and learn to direct their own explorations. Ultimately, students begin to think of learning as accumulated, evolving knowledge.

Constructivist learning requires exploration on classroom environment. In the study of Emilov (2013), he investigated the science classroom environments. According to Emilov, it is necessary to seek teachers' and students' views on the application of constructivist-based teaching and learning practices and thus to explore science classroom environment. It is therefore necessary to know the perceptions of the students on constructivist learning. In this study, an attitude questionnaire is deemed necessary.

Constructivism can be used for the explanation of the nature of scientific knowledge, learning, and teaching. It is viewed not only as a body of knowledge, but also as a student activity. Student activities are embedded in a social context, so the student should be provided with opportunities to represent their own knowledge in a variety of ways and contexts. To provide these opportunities, the teacher does not act as a transmitter of knowledge, but as a scaffolder and facilitator who plays an important role in supporting and enhancing student science learning (Faikhamta, 2007). The implications of a constructivist-based view of learning are that the students are encouraged to learn and exchange existing

knowledge for new knowledge using the various ways. Students construct or reconstruct their own knowledge by the support and guidance of their teacher collaboratively working with other students in the class.

Tytler and Prain (2010) conducted a study on the framework for rethinking learning in science from recent cognitive science perspectives. The findings suggest this framework provides strong theoretical and practical insights into how children learn. They emphasized that the nature and process of conceptual change can be re-interpreted in terms of the development of students' representational resources. Thus, a student can be able to eradicate his preconceptions and derive conceptual change after the performance of a certain task. In constructivism, students will be able to construct their ideas out of their experiences and learning from the activities performed and able to achieve the desired learning outcomes.

21st Century skills and learning outcomes such as create, construct, present and reflect are necessary to be developed by 21st century learners. Thus, in order for a student to acquire such skills teaching and learning innovations are important. It is therefore timely to conduct a study on outcomes – based education through constructivism.

Adak (2017) investigated how effective the constructivist approach is in ensuring science achievement in the high school level. He used the pretest-posttest control group experimental design. Two comparable classes with 29 students each comprised the experimental and control classes. For three weeks, the experimental class was taught using constructivist 7E-model while the other class was taught using the traditional method. An achievement test was used as tool. It was found out that the experimental class achieved better than traditional class. Further, the experimental class performed significantly higher than the traditional class in terms gained scores in different levels of intelligence. It was concluded that the constructivist 7E-model is effective in enhancing student's mastery of content at the higher order cognitive levels. The researcher recommends that the constructivist approach be used to improve students' science achievement.

Tatli (2013) investigated on the effects of problem solving skills of students exposed to computer simulation versus the traditional teaching method. Results revealed that there is a statistically significant increase in the achievement on the problem solving skills of the students exposed to computer simulation than those exposed to traditional teaching.

Likewise, a study was also conducted to determine the effects of constructivist learning approach on students on their academic achievements in science (Ayaz and Sekerci, 2015). They found out that constructivist learning approach on students' academic achievement makes more significant contributions to learners' academic achievement than does the traditional learning method. They suggested that the use of constructivist learning approach should be used to improve students' achievement.

Aydishe (2015) also tested the effectiveness of constructivist teaching method on students' mathematic achievement. He noted that in a constructivist classroom, it is like that of a training workshop where students learn from each other and teach one another. They accept collaboration as a principle of learning. In this collaborative approach, the teacher's role is to set a framework for students learning and organize a discovery period in which students have direct relationship with materials and tools, and they learn how to learn. Therefore, teacher's role is that of a facilitator who develops the critical thinking and creative skills of the students.

Different action researches have been conducted to prove the effectiveness of different constructivist approaches in teaching. These are studies on Process Oriented Guided Inquiry Learning or POGIL and Teams Games Tournament or TGT to name a few. These were all introduced by different educational researches aiming to improve science education globally and locally.

There are different teaching strategies that can be applied in outcomes based education. In her slides entitled "Constructivist Teaching Method: The Road to Higher Achievements," Anderson (2009) emphasized on two constructivist learning methods - the cooperative learning and the problem based learning. The 5E Model developed by Biological Sciences Curriculum Study Science Educators in 1987 was expanded and improved by Eisenkraft in 2003 and became the 7E learning cycle. These are all developed from the model of Driver and Oldham (1986) who constructed a 4 –phased constructivist learning model. This learning model is the basis of the Outcomes-Based Learning Guide Model which was developed by the researcher purposely for this study.

The Constructivist teaching sequence of Driver and Oldham motivated the researcher to construct an outcomes-based-constructivist learning guide model. The model was innovated by the researcher in order to fit to the needs of 21st century learners.

Outcomes based learning using constructivism is a modified learning model constructed by the researcher. This is used in teaching physics. The outcomes based learning guide includes five stages. The model constructed is generic in such a way that it can be used with any of the strategies to be employed as a constructivist approach in teaching physics.

The first phase includes orientation of the tasks. It involves formulation of learning objectives. The instructor orients the students about what they are expected to do. The students are provided with questions for them to think about. The initial ideas about the concepts covered in each lesson are solicited. The initial phase of the learning cycle aims to focus their attention to the

essential concepts to be learned and the tasks to be undertaken.

The second phase is called elicitation. Here, cooperative groups are formed. Each small group performs practical activities or experiments. Each group discusses experimental results and answer questions using the learning guide to be developed. The instructor at this stage emphasizes cooperative learning as the group's goal. The elicitation phase aims to provide students' opportunity to clear out their prior concepts. Most of the questions given in this phase are open-ended and the experiments involve less computations and measurements.

The third phase is called restructuring. In this phase, the whole class is convened for the sharing period. The cooperative groups present and defend their own outputs to the whole class. The instructor encourages the students to participate actively in the discussion. The instructor serves as a facilitator and does not comment on the student ideas they present. In this phase, the instructor encourages each student to challenge conceptualization of ideas. After their presentation, argumentation and finally agreement on the concepts presented, the instructor gives the correct answers to the questions asked in the learning guide. The cooperative groups then evaluate their own outputs. Then finally, the instructor formally discusses mathematical formulations and numerical applications of the concepts learned.

The fourth stage is called application and review. In this phase of the teaching model, the students are exposed to more complex problems. They solve the problems in cooperative groups. After solving, the members of the group share and explain their solution to the whole class. After the whole class discussion, the instructor presents the correct solution.

The fifth phase is called outcomes. In this final phase, the students are asked to connect the concept to different contexts, and they are able to transfer new learning. This phase determines the learning outcomes of the students. In this phase the students are expected to design or construct an improvised apparatus applying the concepts they have learned in the preceding stages.

The input includes the new curriculum in the K to 12 course syllabus, the college physics syllabus of the College of Teacher Education needed in the preparation of the learning guide, attitude survey towards constructivist approach in learning, and the Conceptual Survey on Electricity and Magnetism. The process involves the development of the outcomes based learning guides in physics and the teaching approach. The constructivist model of teaching which was designed by the researcher allows students to learn by constructing their own meanings out of their experiences. The qualitative part of this research is a triangulation through Focus Group Discussion (FGD). This was conducted to validate the results in the quantitative part. Outcomes-based Learning Guides in Electricity and Magnetism using Constructivism serves as the output of this study.

OBJECTIVES

This study aimed to develop and validate outcomes-based learning guides in electricity and magnetism using constructivism. The specific objectives were as follows:

1. To determine the assessment of the group of evaluators of the outcomes-based learning guides in electricity and magnetism in terms of the following dimensions:
   a. Learning Outcomes;
   b. Content;
   c. Structure and Organization;
   d. Learning Activities; and
   e. Evaluative Activities.

2.To determine the levels of attitude of students towards constructivist learning method before and after their exposure to the outcomes- based learning guides in electricity and magnetism using constructivism.

3. To measure the performance of the students on the pre-test and posttest using the outcomes- based learning guides in electricity and magnetism using constructivism.

4.To test for significant difference in the attitudes of the students before and after their exposure to the outcomes-based learning guides.

5. To test for significant difference between the pre-test and posttest scores of the students before and after their exposure to the outcomes-based learning guides using constructivism.

METHODOLOGY

This study employed the quantitative and qualitative methods of research. The quantitative part utilized the descriptive and experimental designs to describe the evaluation of the developed outcomes-based learning guides in electricity and magnetism, the pretest and posttest results, and the attitudes of the students exposed to the outcomes based learning method. The qualitative part of the study was done through Focus Group Discussion to determine the perceptions of the students on the use of the learning guides, on outcomes based education, on constructivism and other aspects of the physics learning process.

In validating the developed outcomes-based learning guides in electricity and magnetism using constructivism, five evaluators assessed and validated the research

instrument in terms of learning outcomes, content, structure and organization, learning activities and evaluative activities. The pool of evaluators includes physics experts in the tertiary level from different universities in the Philippines.

Twenty-four students served as participants in the study. These are the physics students of the College of Teacher Education, University of Northern Philippines, Vigan City during the second semester of school year 2016-2017.

Instrumentation and data collection were carried out in different phases. The planning phase involved the revisit of the course syllabus being used in College Physics subjects in the University of Northern Philippines. It was focused on the review of learning outcomes and teaching strategy used in teaching college physics. The course syllabus was prepared by the researcher and was checked and reviewed by the Dean of the College of Teacher Education and approved for use. This stage also includes intensive and extensive review of literature on outcomes based and constructivism.

The development stage involved the writing of the outcomes based learning guides in electricity and magnetism using constructivism. Topics particularly on Electrostatics, Electrical Conductivity, Series and Parallel Circuits and Electric Field Measurement were the focus of the learning guide. The constructivist teaching sequence formulated by Driver and Oldham was modified to include the outcomes at the end of the process.

In the content validation phase and revision of the material, the final draft of the learning guide was reviewed by the pool of evaluators. A validation instrument using a five-point scale was utilized to determine the content and instructional characteristics of the developed learning guide. Modification was done following the suggestions of the evaluators. This phase also included the testing of the learning guide to the learners.

Prior to the experimentation was the administration of the Pre-Attitude Survey Test towards Constructivism and the Pretest on the Conceptual Survey on Electricity and Magnetism (CSEM). The attitude survey towards constructivist learning is composed of fifty-six items adapted from Nix and Fraser (2005). It is a questionnaire on how the students feel and act on a constructivist learning environment. The Conceptual Survey on Electricity and Magnetism or CSEM was developed by Maloney et al. (2001). It is a 32-question, multiple-choice application and analysis test. It is composed of eleven (11) easy questions, thirteen (13) average questions and eight (8) difficult questions. It covers topics on Conductors and Insulators, Circuits in Parallel and Series, Coulomb's Law, Electric Force, Induced Charge and Magnetic Field.

The outcomes based constructivist learning model is a modified learning model constructed by the researcher. The constructivist approach include five phases, namely, Orientation, Elicitation, Restructuring, Application and Review, and Outcomes. Each student was given learning guides. The pilot testing of the learning guides was conducted in six weeks from April 8, 2017 to June 18,2017. After the treatment period, the posttest and the attitude towards constructivist learning questionnaire were administered. The Focus Group Discussion with twelve (12) students as participants was conducteda week after the experimentation.

Frequency mean was used to analyze the evaluation of the validators and the perceptions of the students on the use of the constructivist learning guide. This was also used to describe the pre-test and post-test scores of the students. The t-test was used to determine the significant difference between the pretest and post test scores of the respondents in pilot testing of the learning guide.

RESULTS AND DISCUSSION

Assessment on the Learning Guides

The validation of the Learning Guides in Electricity and Magnetism was done by five physics experts. They rated the learning guides as "very highly attainable" in terms of learning outcomes, "very highly valid" in terms of content, "outstanding" in terms of structure and organization, and "very highly appropriate" in terms of both learning and evaluative activities. Overall, the guides were assessed by the evaluators to have "very high validity." These results indicate that the said materials are very highly suited to guide students in learning Electricity and Magnetism under an outcomes-based constructivist approach.

Levels of Attitude of Students towards Constructivist Learning Method

Students' attitudes towards constructivist learning were noted. Most of the item means measuring pre-attitude and post-attitude fall within the "often" level. The means after exposure to a constructivist learning environment are higher than those prior to exposure. Although overall mean indicates "often" level, the attitudes of the students towards constructivism were improved.

There are ten items in the attitude survey test in which the level was improved. Results for item 12, show that it was okay for them to ask their teacher why they have to learn a certain topic, the item means rose from "sometimes" level to "often" level. The means for items 13, 14 and 18, which indicate whether the students asked questions the way the teacher ask them, whether they complain if they perceived the lesson as confusing, and whether they were given opportunity to plan with the teacher on what should they learn, the means increased from "seldom" to "sometimes" level.

Four more items had means which became higher after the students were exposed to the constructivist approach, in which the original "sometimes" level became "often" level. The students admitted that they like asking questions and leading their fellow students to ask questions too (item 34), presenting work before the teacher, and other students and other teachers (item 46), and making projects in which they apply what they have learned (item 47), and revealed that their prior knowledge was acknowledged in the class (item 52).

Further, the students were free to express their opinions as the mean for item 16 rose from "often" to "always" level. The same result was observed for item 43 which shows that the students appreciated performing experiments or activities with their classmates. Finally, on item 56, the students claimed that they were encouraged to construct their own ideas; however, the mean indicated a change from "always" level to "often" level.

Level of Performance of the Students in the Conceptual Survey on Electricity and Magnetism

The students got low performance during the pretest as indicated by the mean score of 5.00. Their performance in the posttest was higher than the pretest as shown by the mean score of 23.96. The very satisfactory performance of the students during the posttest is accounted to their exposure to the outcomes-based learning guides using constructivism.

Attitudes of the Students Before and After their Exposure to the Outcomes-Based Learning Guides in Electricity and Magnetism

The post-attitude mean score is 0.23 higher than the pre-attitude mean. The t-value obtained was 3.947 which is significant at the .05 probability level. This result shows that the post-attitude level of the students is statistically higher than their pre-attitude level. The significance of the mean difference is due to the students' exposure to the outcomes-based learning guides using constructivism which implies that the students appreciated the constructivist nature of the teaching-learning method implemented.

Difference in the Performance of the Students in the Pretest and Posttest

The test for significant difference between the pretest and posttest mean scores of the student was determined. The pretest mean score is 18.9 higher than the pretest mean score. The t-value obtained was 27.364 which is significant at the .05 probability level. This result shows that the posttest performance of the students is statistically better than their pretest performance. The significance of the mean difference is explained by the students' exposure to the outcomes-based learning guides using constructivism. This means that the students gained from the constructivist nature of the teaching-learning method implemented which emphasized outcomes-based learning. The result proves that the treatment was able to improve the understanding of the students of the various topics of Electricity and Magnetism.

CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn:

1.The validated outcomes-based learning guide in electricity and magnetism using constructivism is very highly suited to guide students in learning Electricity and Magnetism under an outcomes-based constructivist approach.
2. There is a slight enhancement of the attitude of the students after the use of the learning guide. The duration of the intervention was not enough to change the attitude of the students. Attitudes do not simply change in a short period of time. After the exposure to the constructivist teaching method, the students became more appreciative of the approach used.
3. The use of the Outcomes-Based Learning Guide in Electricity and Magnetism using Constructivism was able to increase the level of performance of the students on the concepts of electricity and magnetism. The use of constructivism as an approach is effective in improving the level of performance of the students in electricity and magnetism.
4. The significant difference between the pre- attitude and post attitude of the students towards constructivism is due to their exposure to the outcomes-based learning guide in electricity and magnetism using constructivism. The students appreciated the constructivist nature of the teaching-learning method implemented.
5. The Outcomes Based Learning Guide in Electricity and Magnetism using Constructivism was able to increase the levels of performance of the students. The effectiveness of the model in bringing out transformation in students' performance was seen after their exposure to constructivism. Thus the Outcomes –Based Learning Guide in Electricity and Magnetism Using Constructivism is useful in teaching physics. Constructivism is proven to be an effective teaching approach in physics.

RECOMMENDATIONS

Based on the findings and conclusions of this study, the

following recommendations are forwarded:

1. The results of this study may be presented and disseminated in a research conference in order for other science teachers to adopt in their science teaching.
2. The use of constructivism in teaching physics may be one of the teaching approaches to be employed in science teaching to improve students' attitude toward constructivism in a longer period of time.
3. Teachers are encouraged to develop other learning guides in other topics in physics. However, in the learning guide, they should include safety precautions in conducting the experiment.
4. Teachers are invited to attend trainings and seminar workshops to enhance their knowledge and skills in constructing intervention materials to be utilized in improving instruction.
5. Further studies might be conducted on the use of outcomes-based learning and in the use of constructivism in teaching physics.

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