EFFECTIVENESS OF CHEM-CONNECT PROJECT IN MANAGING LARGE CLASSES IN CHEMISTRY

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Abstract

Large class size is often perceived as one of the factors affecting quality education. With the low performance of the students in science due to large class size, there is a pressing need to implement interventions that will address the abovementioned problem. One of these interventions is the Chem-Connect Project, which is a combination of innovative teaching strategies and techniques including Practical Work Approach, ICT applications, and Chemistry promotion in the school and community. This study was conducted to determine the effectiveness of Chem- Connect project in managing large classes in Chemistry specifically its effects on enhancing students' performance. Quasi experimental method of research utilizing the pretest-posttest design was employed in this study to determine the effects of the project on students' Chemistry achievement. The two Chemistry classes of the researcher intact served as the research participants of the study, one experimental and one control group, composed of 51 students each. The implementation of the project showed a promising results since it significantly improved the Chemistry performance of the students. There is a significant difference in the pre-post mean gain in the performance of experimental group in Chemistry. Likewise, significant difference existed between the two groups favoring the experimental group during the posttest. With this, the Chem-Connect Project was effective in managing large Chemistry class. The implications of the results can serve as baseline in employing Chem-Connect Project especially in handling large science classes to promote effective science learning.

Keywords: Large Classes; Chemistry performance; Practical Work Approach; Chemistry Promotion in the School and Community; ICT; Attitude towards Chemistry

Introduction

Large classes are often perceived as one of the factors affecting the delivery of quality education (UNESCO, 2006). These are also one of the perennial problems faced in the Philippine educational setting, especially in the public school system. The problem on large class is currently one of the challenges that confront the public educational system in the Philippines.

With the increasing number of enrolment in public secondary high schools, the quality of education especially in science is somehow affected. This is evident in the National Achievement Test results where the average performance level for the past few years is below 75%, which is below government standards.

Class size has been found to impact negatively on student engagement, especially in the large class size (Kerr, 2011). Instruction in large sized classes yield reduced student level of active involvement in the learning process, reduced frequency and quality of teacher's interaction with and feedback to students, reduced student motivation, and reduced development of cognitive skills inside the classroom (Cuseo, 2007; Iaria & Hubball, 2008).

In large classes, students are more likely to experience sense of anonymity, passive learning, and distraction which can have negative impacts on their learning, attrition, and motivation for learning (Iaria & Hubball, 2008). In addition, class size could also affect teacher's allocation of time and, hence, effectiveness, in other ways, too (Ehrenberg, Brewer, Gamoran, & Willms, 2001).

With the intended negative effects of large classes, there is a pressing need to upgrade science instruction to raise the level of performance of students especially those schools with large classes. Providing tools to address the difficulty of teaching large classes is thus an important step towards realizing quality Education for All (EFA) in school settings. In addition to what the Department of Education (DepEd) is doing to elevate the performance of the students, the researcher has investigated the possible intervention that would enable the teacher to manage large classes effectively, uplift students' achievement as well as foster their interest in learning science. Hence the Chem-Connect Project was implemented with research evidence reported in this paper.

Chem-Connect is a project that was implemented in TNHS to manage large class in Chemistry, a subject that is often tagged by many students as one of the difficult fields of discipline. This is because studying Chemistry requires a high intellectual ability (formal thinking skills) for the students to connect concepts to their existing lives, concretize abstract concepts and appreciate its usefulness in daily life activities. The high level of abstraction of chemical concepts sometimes leads to misconception.

In the Chem-Connect Project, various innovative teaching strategies and techniques in each Chemistry topic were employed: Practical Work Approach, ICT applications, and Chemistry promotion in school and in the *barangays* or communities of people. This project is very promising and unique among others since the teaching and learning process does not end within the walls of the classroom; what the students learned about Chemistry are being shared to other students in the school and to the people in the community. Activities that involve Chemistry were also shared especially those that can serve as means of livelihood of the people in the community.

With this project, it is expected that students would be able to understand abstract Chemistry concepts through scientific investigations, determine and appreciate its practical applications, as well as connect Chemistry concepts to daily life activities through their Chemistry promotion activity in the community, despite the large class size.

Research Questions

1. What is the pretest and posttest performance of the students in selected Chemistry topics for the
    1.1 control group?
    1.2 experimental group?

2. Is there a significant pre-post mean gain in students' performance in Chemistry for the
   2.1 control group?
   2.2 experimental group?

3. Is there a significant difference between the mean gain in students' Chemistry performance of the
   3.1 control group?
   3.2 experimental group?

Research Hypothesis

H_o1: There is no significant difference in the mean gain of the experimental and control group respectively.

H_o2: There is no significant difference between the mean gain of the experimental and control group.

Methodology

Research Design

Quasi experimental method of research utilizing the pretest- posttest design was employed in this study to determine the effects of the project on students' Chemistry achievement.

Research Participants

For easy monitoring and evaluation of the project, the two Chemistry classes of the researcher served as the research participants of the study. The III- Hydrogen and III- Lithium class served as the experimental and control group, respectively, with 51 students each. The Chem-Connect Project was implemented to the experimental group and the control group was exposed to traditional method of teaching, using the board, visual aids, and conventional laboratory lecture/ demonstration.

Research Instrument

Chemistry Achievement Test (CAT). The researcher developed a 30-item test instrument that was used as pretest and posttest. Various types of test items as summarized using the table of specifications (TOS) were content validated by other Chemistry teachers of the department. These items were designed to measure students' achievement in Chemistry. Topics that were included in the test were Chemical Bonding, Polarity of Substances, Molecular Geometry, Intermolecular Forces, Physical/ Chemical Change, Four Types of Chemical Reactions, Mole Concept and Factors Affecting Rate of Reaction. Open- ended questions were also given to determine if the intervention enhanced the development of inquiry skills of the students in the experimental group.

Procedure

The students who composed the experimental and control group were oriented about the project. A pilot implementation of the project was conducted in June to July 2013 to the experimental group. Revisions and finalizations of the proposed project were done in August 2013.

After revision, implementation of the finalized Chem-Connect Project followed. It started with a pretest on science processes skills administered by the Science Education Institute (SEI) Department of Science and Technology (DOST). The implementer also administered a pretest and posttest after the implementation of the project.

Implementation Proper of the Chem-Connect Project

Use of Chemistry Video Clips. Prior to lesson proper, a three to five minute video clip related to the Chemistry lesson was shown to the students as motivation technique. Through the video clip, students were motivated to ask some questions about it. However, no answers were provided yet to their questions. They were the one who determined the answers through scientific investigations and experiments. This was the time that the practical work approach was employed in the lesson proper.

Practical Work Approach. The Practical Work Approach (PWA), as its name entails, attempts to situate science lessons with the context of the real-life environment (Bumagat, n.d.). It is also defined as any teaching and learning activity which involves at some point the students in observing or manipulating real objects and materials (Millar, 2004). Moreover, it refers to learning situation where the students learn concepts and principles of a discipline in using its process through concrete examples (Magno, 2011).

During the Chemistry class, the Practical Work Approach was employed in the selected topics in Chemistry for the second and third grading period. Scientific investigations and experiments were performed by the students in each topic for them to discover and understand the concept behind the Chemistry lesson. In addition, collaborative activities by learning stations were also employed in this approach.

In the PWA, various techniques were employed by the implementer. Aside from classroom experiments, students made use also of the environment as laboratory of learning. They were exposed outside the classroom with the involvement in observing and conducting scientific investigations. The practical applications of the Chemistry concept were emphasized in this approach and the students determined the concepts behind the Chemistry lesson base on the results of their scientific investigation

A rubric was used to assess performance of the students during experiments and scientific investigations. Some of the scientific investigations and experiment guide were taken from the University of the Philippines-National Institute of Science and Mathematics Education (UP-NISMED) Sourcebook on Practical Work for High School Chemistry (Magno, 2011).

Scavenger Hunts and Blogging. Since learning is not only confined to the walls of the classroom, other ICT applications were employed in the learning process like blogging and scavenger hunting. These techniques are very promising especially to large classes since students can even learn outside the classroom.

One of the ICT applications used in the Chem-Connect Project is blog. The term blogs, or sometimes referred to as weblog, is currently used to refer to online journals. A defining feature of a blog is the order in which posts are arranged on the site. A blog is primarily a website that is frequently updated with new posts. The posts are arranged in reverse chronological order, with the most recent entry at the top of the blog. Blogging as a process is different from other forms of search-retrieve-comment on discussion boards, as the blog is open to the wider public to view. This ability to be read by a wide variety of people requires the writer, or 'blogger,' to present their thoughts in a way that perhaps more accurately reflects personal views or arguments (Martindale & Wiley, 2004). Because of this personal nature, students are afforded the opportunity to reflect on what they are learning and share personal views and opinions. As students are conducting research into content areas that they are studying, they can add hyperlinks to articles, URLs, or other research into their blog to aid visitors in understanding the development of their conceptualizations (Ferdig & Trammell, 2004).

In this study, a Chemistry blog was constructed where blogging among the students and teacher took place. The students were comprehensively oriented by the teacher on what to do during the blogging process. The blogsite contained texts, pictures and archives where the students shared their reflections and learnings as well as promoted the importance and practical applications of Chemistry to daily life. Important Chemistry reference materials were also uploaded in the blog so that even if the students were not in their classroom, they could still learn Chemistry. Exchange of ideas and collaboration among the students were also done in this blog. Blogging was done by the students individually once a week, preferably during weekend, in the computer shops or at their own home if they have access to computer since the computer room is always used by the science-oriented classes.

Instead of giving the students the usual assignment where they will just refer to the book, a Chemistry scavenger hunt was assigned to the students. Scavenger hunt is a tool for teaching the students how to search for information while using the Internet and provide an interesting format for instruction. This was made by the researcher and was administered to the students in the experimental group. Literature revealed Chemistry scavenger hunt helped students to avoid mindless surfing of the web since this already consisted of questions related to the selected topics in Chemistry and the URLs/website addresses were provided by the teacher for the students to answer the questions easily in this study. It also consists of "Big Question" for the students to synthesize Chemistry concepts (Rozich, 2000). Usually, scavenger hunt was provided after each Chemistry lesson.

The reward system to those students who performed blogging was called PowerPoints. The number of times they have blogged was counted, transmuted, and incorporated in the performance component for the computation of grade. The students who blogged ten times were also given one free ten item quiz. However, the quality of what the students have blogged was also considered in giving PowerPoints. On the other hand, the scavenger hunt was checked according to the correctness of answer and was graded under the assignment component of students' grades.

Chemistry Promotion in the School and the Community. Activities on Chemistry promotion served as enrichment and extension activity of the students in the experimental group. Students were immersed into the selected barangays or communities of people to promote what they have learned from the class. This activity was conducted preferably during weekend or if the students have no classes, in coordination with the barangay captain. Students were grouped according to their residence or proximity to barangay where the Chemistry promotion will be conducted and they were accompanied by some Chemistry teachers. Science games of magic/ tricks were performed and the practical applications of Chemistry concepts were imparted by the students to the people of the community. Activities that involve Chemistry were also shared especially those that can serve as means of livelihood of the people in the community like tie dyeing, soap, vinegar, toothpaste, gel, ice cream making, charcoal 2.0, hand sanitizer, and others. After the activity, a focus group discussion/ interview was conducted with some members of the community who participated as to how the activity helped them appreciate Chemistry.

Same activity was done in the school during the double period schedule in science of the experimental group. Chemistry promotion in the school was done to other Chemistry classes, in coordination with the subject teachers.

The Chemistry Promotion activity was fully supported by the TNHS administration by providing additional funds, General Parents-Teachers Association (GPTA), Local Government Unit of Tabaco, private sponsors, government official of the province of Albay, and the different community officials.

Figure 1 is the schematic diagram of the learning strategies incorporated during the implementation process of Chem-Connect Project as discussed earlier.

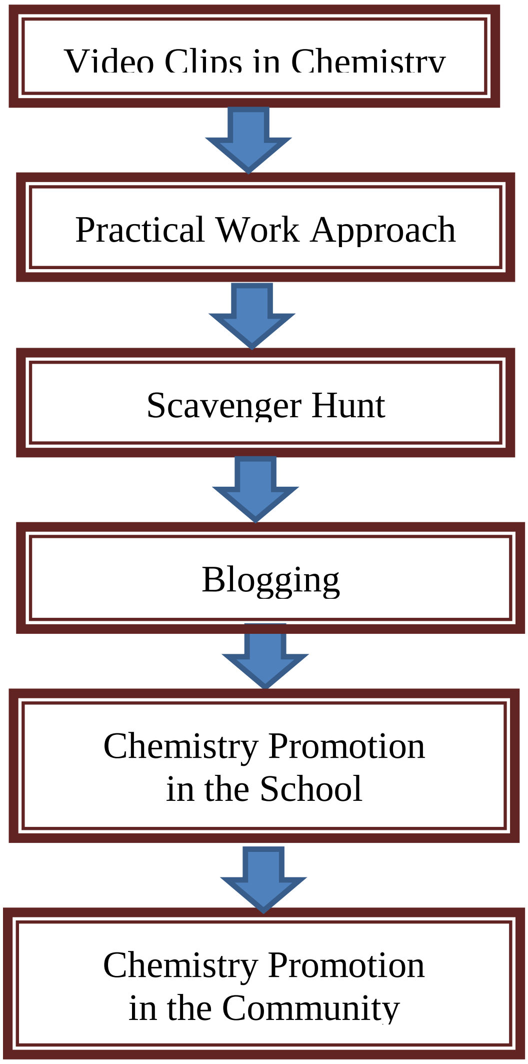

Figure 1. Schematic diagram of the learning strategies in the Chem-Connect Project.

Data Analysis
Data were treated statistically using t-test to determine the significance difference on students' achievement in Chemistry. Mean was used to determine students' achievement in Chemistry.

Results and Discussion

Table 1 reveals that the control group obtained a higher pretest result compared to experimental group, and both groups have low mastery on the concepts in the test. The posttest result however shows that the experimental group obtained a higher mean as compared to the control group. Nevertheless, both groups attain the near full mastery of the concepts in the test, as specified in the DepEd National Achievement Test (NAT) mastery level of learning competencies.

Table 1
Pretest and Posttest Results

Groups	Pretest Mean	Performance Level	Posttest Mean	Performance Level
Experimental	4.46	35%	19.58	90%
Control	6.13	45%	13.87	83%

Table 2
Descriptive Equivalent (Taken from the DepEd NAT Mastery Level of Learning Competencies)

Performance Level	Mastery Level Descriptive Equivalent
92% above	Full mastery
83%-91%	Near Full Mastery
75%-82%	Mastery
51%-74%	Near Mastery
25% -50%	Low mastery
24% below	No Mastery

The notable increase in the performance of the experimental group can be attributed to the intervention implemented.

Table 3
T- test Result for the Mean Gain of Student's Chemistry Performance

	Groups	Mean Gain	T-test
Pre-post	Experimental	15.12	2.12*
Pre-post	Control	7.74	1.86

*Significant at 0.05 level of significance, t-crit = 2.01

The data table shows that the experimental group obtained a higher mean gain compared to the control group. The computed t- value of 2.12 for the experimental group is significant at 0.05 level of confidence, which means that there is enough evidence to reject the null hypothesis (H_o1). There is a significant difference in the pre-post mean gain in the performance of experimental group in Chemistry.

The improvement of students' performance in the experimental group is explained by the fact that various strategies and approaches were introduced in the Chem-Connect Project, which enhanced the scientific skills and promoted students' interest in learning Chemistry.

This claim can be further supported by the reviewed literature that practical work, which is one of the approaches in the project that develops students' scientific knowledge as well as tacit knowledge of scientific enquiry. Because some explicit understanding of the logic of scientific enquiry and of the nature of scientific knowledge is important for scientific literacy, targeted practical tasks can be very useful for developing such understanding, in particular ideas about data interpretation (Millar, 2004). Good quality practical work can engage students, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts. A further consequence of experiencing practical work, particularly in chemistry, is the acquisition of an understanding of hazard, risk and safe working especially during the conduct of experiments (Woodley, 2009).

The use of ICT, which is another feature of the Chem-Connect Project, provides advantages over traditional method of teaching. Klemp and Trautman (2002) studies on ICT revealed that the students were motivated and there's a greater academic gain after implementing ICT. Students immersed to ICT have excellent communication, creativity, collaboration, leadership skills and technology proficiency (Martinez, 2010). Moreover, the use of blogs can promote critical and analytical thinking, potential for increased access as well as exposure to quality information, combination of solitary and social interaction (Richardson, 2006). Furthermore, Martindale and Wiley (2004), Ferdig and Trammell (2004), as well as Ngeow and Kong (2003) emphasized that blogging promotes reflective learning among the students, which can therefore enhance their analytical skills.

Table 3
t-test Result for the Difference Between the Experimental and Control Group in their Chemistry Performance

Test	Groups	Mean	Mean Diff.	T-ratio
Pretest	Experimental Control	4.46 6.13	1.67	2.61*
Posttest	Experimental Control	19.58 13.87	5.71	8.76*

*Significant at 0.05 level of significance, t-crit=1.99

The result of the pretest showed a significant difference on the performance of the experimental and control group, favouring the latter group. Moreover, significant difference existed between the two groups favouring the experimental group during the posttest. Thus, Ho2 is accepted since the computed t-value is higher than the t-critical, which is 1.99 at 0.05 level of significance. It appears therefore that the use of Chem-Connect Project is better than the traditional method, which means that intervention is effective.

Conclusions

The Chem-Connect Project was effective in managing large classes in science since it significantly improved the Chemistry performance of the students in the experimental group.

Recommendations

1. Chem-Connect Project should be employed in teaching especially among large classes to support students' learning in the sciences.
2. The Chem-Connect Project could be replicated to other large classes and other learning areas.
3. The Chem-Connect Project could be applied to other year level and other sections such as lower, middle, higher sections.

4. A division training on the Chem-Connect should be conducted among the teachers for them to adopt/replicate the project especially if they are handling large classes in their respective schools.
5. Further study about Chem-Connect Project is encouraged to find out its effectiveness in managing large classes to other learning areas/ subjects.

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