Effects of *Grade 9 Science Learner's Material* on students' self-regulation and achievement in Chemistry

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ABSTRACT

The study was conducted to investigate the effectiveness of Grade 9 Science Learner's Material on self-regulation and achievement of students in Chemistry. Specifically, it sought to find out if: (1) students exposedto Grade 9 Science Learner's Material (Grade 9 LM) have higher self-regulation in chemistry compared to those who were exposed to the Traditional Learning Material (Traditional LM); (2) students expose to Grade 9 LM have higher achievement in chemistry than those who were exposed to Traditional LM; and (3) which domains of self-regulated learning (SRL) were evident among Grade 9 LM and Traditional LM.

The study employed pretest-posttest quasi experimental research design. The sample of the study consisted of two (2) intact heterogeneous sections of Grade 9 students in a public school in City of San Fernando, Pampanga who are enrolled during the School Year 2014-2015. Thirty five (35) students are in the Grade 9 LM class while Thirty five (35) students are in the Traditional LM class. Instruments used in the study were: (1) Self-Regulation Questionnaire (SRQ) to assess students' self-regulation and (2) Chemistry Achievement Test (CAT) to measure achievement in Chemistry. The instruments were all content validated by panel of experts and were pilot tested.

The following are the findings and conclusions in the study: (1) The mean posttest in the Self-Regulated Learning was significantly higher for students exposed to Grade 9 Science Learner's Material Group than for students exposed to Traditional Material Group; (2) The mean posttest in Chemical Bonding and Mole Concept were significantly higher for student s exposed to Grade 9 Science Learner's Material Group than for students exposed to Traditional Material Group; and (3) There was no significant difference in the mean posttest scores in the Carbon Compounds and Chemistry Achievement Test (CAT) of students from both groups.

The Grade 9 Science Learner's Material enhanced students' self-regulatory process. In the SRL, the triggering, formulating and searching domains were evident in the Grade 9 LM while the implementing, evaluating and receiving domains were marked in the Traditional LM.

Keywords: Grade 9 Science Learner's Material, Self-Regulated Learning, Achievement in Chemistry

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Introduction

Learning is an act, process or experience of gaining knowledge or skill and it can be acquired in various ways and means. It is essential for every individual, groups, organization and communities for maturity and coping successfully with changes and challenges in everyday life. Today, learning is conceived as an active, cognitive, constructive, significant, mediated, and self-regulated process (Beltran, 1996). Achievement of significant, self-regulated learning requires both will and skill (Blumenfeld & Marx, 1997; McCombs & Marzano, 1990). Recognition of the importance of personal initiative in learning has been reaffirmed by contemporary national leaders such as Gardner (1963), former Secretary of Health, Education, and Welfare, who suggested that "the ultimate goal of the education system is shift to the individual the burden of pursuing his own education" (p.21). For this reason, education should help students to be aware of their own thinking, to be strategic and to direct their motivation toward valuable goals. The goals are to enable students to become independent and self-sufficient individual who are able to manage their behavior without the assistance of others (Copper, Heron & Heward, 2007; Lance 2005) and learn to be the master of their own learning.

However, Luz (2007) found that among the skills which were difficult to ascertain in terms of degree of attainment were practical knowledge and skills of work. High school graduates show deficiencies in their ability to communicate, to think logically and to solve problems. Such deficiencies show that students are not self-regulated. Also, Ruohoniemi and Lindblom–Ylanne (2009) found that learners were not all intentional, independent or self-directed.

Self-regulation is essential to the learning process (Jarvela &Jarvenoja, 2011; Zimmerman, 2008). It can help students create better learning habits and strengthen their study skills (Wolters, 2011), apply learning strategies to enhance academic outcomes (Harris, Friedlander, Sadler, Frizzelle, & Graham, 2005), monitor their performance (Harris et al., 2005), and evaluate their academic progress (De Bruin, Thiede & Camp, 2011). Over the past years, there has been very little empirical evidence regarding how students become masters of their own learning, a topic that has become known as self-regulated learning (Zimmerman &Schunk, 1989). Self-Regulated Learning (SRL) refers to learning that results from students' self-generated thoughts and behaviors oriented systematically toward the attainment of their goals (Zimmerman, 2001). It is not a mental ability or an academic performance skill; rather it is the self-directive process by which learners transform their mental abilities into academic skills. It is also conceived to be a learning process that is guided by *metacognition* (thinking about one's thinking), *strategic action* (planning, monitoring, and evaluating personal progress against a standard), and *motivation to learn* (autonomy and control over the situation) (Perry, Phillips, &Hutchinson, 2006; Zimmerman, 1990; Boekaerts &Corno, 2005).To become self-regulated students must know how to control and manage their behaviour towards their goal. That is being aware of one's motivation and generating self- motivation towards the attainment of goal.

Self-regulated learners are proactive in their efforts to learn rather than covert in reaction to teaching because they are aware of their strengths and limitations. They have more control over their learning (Zimmerman, 2002). Once students are self-regulated they will eventually become life-long learners, which is one of the goals of the Department of Education (DepEd).

Recently, the government of Philippine Education introduced the Republic Act 10533 which is the "Enhanced Basic Education Act of 2013" or the "Enhanced Basic Education Curriculum" of the DepEd. The implementation of the K to 12 education plan in the Philippine Basic Education Curriculum is the key to the nation's development. Under this new curriculum, students are provided sufficient time to master concepts and skill, develop into lifelong learners, and prepare graduates for tertiary education, middle-level skills development, employment and entrepreneurship. These are all possible when students are exposed to and engage with the learning materials or modules provided by the DepEd. The activities in the learner's material were developedin linewith the features of the new curriculum.

This study answered the following research questions:

(1) Did students exposed to Grade 9 Science Learner's Material have higher self-regulation in Chemistry than those who were exposed to the Traditional Learning Material?

(2) Did students exposed to Grade 9 Science Learner's Material have higher achievement in Chemistry than those who were exposed to the Traditional Learning Material?

(3) Which domains of Self-Regulated Learning (SRL) are evident among Grade 9 Science Learner's Material and Traditional Material?

Literature Review

Grade 9 Science Learner's Material

The Enhanced K to 12 Basic Education Program of the DepEd pointed out that the K to 12 reform initiative is an effective cure to the deteriorating quality of the Philippine education system. The low achievement score of Filipino students in the National Achievement Test (NAT) is one indicator of a defective education system. The DepEd strongly believes that the K to12 program will give every learner the opportunity to receive quality education based on an enhanced and decongested curriculum that is internationally recognized and competitive.

Upon the implementation, the DepEd provided learner material which contains all information and resources that learner needs to successfully complete a subject. These include activities which were developed, reviewed and encoded by experts in the field from both private and public school. The said activities are in linewith the features of the reform-based curriculum. This was supported by the National Science Education Standards which stated that –"*science teaching must involve students in inquiry-oriented investigations in which they interact with their teachers and peers* (NRC, 1996, p. 20). Active science learning means shifting emphasis away from teachers presenting information and covering science topics.

One of the main elements which will ensure efficiency in learning is the use of materials (Yalin, 2003).Use of materials in teaching can be identified as the use of supporting elements which enrich the education and teaching setting, facilitate efficiency and persistency in learning and concretize addressing the sense organs of the learner. Activities which provide students with the opportunity to switch freely and continuously between collecting, processing and interpreting the data, may prove fruitful and effective for a better learning (Coelho & Sere, 1998).

Moreover, Dogara and Ahmadu (2000) defined learning materials as anything that helps to bring about success in the classroom. In the science class, learning materials are needed to supplement the teacher's oral explanation with the students' visible experiences. This is why Abdullahi (1982) stated that scientific materials used in teaching enable the students to become actively involved intellectually, perceptually and physically in the learning process.

One way to motivate students and ensure a relatively easier learning process is to make use of materials addressing more than one sense organ(Vural, 2004). What these materials do is promote understanding of concepts through senses. Also, the more of the senses contributed in a lesson by instructional materials the more reality is stimulated. It is in line with this thought that Ema and Ajayi (2004) stated that instructional materials are all the tools, which can be used by the teacher to provide help and encouragement to learners. Such materials bring together human and materials in a systematic co-operation to effectively solve educational problems.

Self-Regulated Learning

Research on self-regulation of academic learning and performance emerged more than two decades ago to answer the question of how students become masters of their own learning processes. Unlike measures of mental ability or academic performance skill, self-regulation refers to thoughts, feelings and actions that are planned and adapted to the attainment of personal goals (Zimmerman, 2000). However, recent methodological advancements have allowed educational researchers to examine not only *what* students learn, but also *how* they learn. According to Schunk and Ertmer (2000), self-regulated learning includes: (a) Setting goals for learning; (b) Concentrating on instruction; (c) Using effective strategies to organize ideas; (d) Using resources effectively; (e) Monitoring performance; (f) Managing time effectively; and (g) Holding positive beliefs about one's capabilities. Moos and Azevedo (2008), for example, have used a think-aloud protocol to capture the dynamic nature of how individual students use strategies, monitor emerging understanding, and make plans during learning. Such differences in how students learn explain variability in what they learn.

Ideally, students actively engage in the learning process. Setting meaningful goals, selecting appropriate and task-specific strategies, monitoring motivational levels, and adapting based on feedback are all positively related to learning outcomes (Azevedo & Moos, 2008; Azevedo et al., 2010). However, empirical research has provided process data that reveal the substantial individual differences with which students engage in the learningprocess. Certainly, individual cognitive characteristics, motivational levels, and developmental constraints affect how studentslearn. A fundamental question arises as to how teachers can best support students' development and use of learning processes. Researchers have identified several self-regulatory processes that students instigate, modify, and sustain. These include attending to instruction, cognitively processing information, rehearsing and relating new learning to prior learning, believing that one is capable of learning, and establishing productive work and social environments. It is also recognized as an important predictor of student academic motivation and achievement. This conforms to the findings from recent studies that self-regulated learners perform better on academic tests and measures of student performance and achievement (Schunk & Zimmerman, 2007; Zimmerman, 2008). Research supports the idea that self-regulation skills can be taught and once used, will be predictive of academic success (Pintrich & De Groot, 1990; Zimmerman, 1990).Students who can conduct self-regulated learning have a clear idea of how and why a specific self-regulatory strategy should be employed. They are active learners in terms of metacognition, motivation and action control. For example, they focus on enhancing their learning performance, employ self-regulatory strategies, give themselves feedback and improve their learning based on that feedback. As a result, they change their sense of self or learning strategies.

In the process of self-regulated learning, learners need to set their learning goals, make their learning plans, choose their learning strategies, monitor their learning processes, evaluate their learning outcomes and suppress interference. Lei and his research fellows (2002) believe that high achievers' self-regulation ability is more developed than that of low achievers. The importance of self-regulated learning lies in providing students with successful experience in order to enhance their intrinsic motivation and promote their self-regulation ability (Boekaerts, Pintrich & Zeidner, 2000).

Zimmerman was the first academic to propose the construct of self-regulated learning in educational psychology (1989). He believes that self-regulated learning is a process in which learners actively participate to some extent in their own learning in terms of metacognition, motivation and action. He also proposes a model of self-regulated learning in order to illustrate how learners actively employ specific strategies in their study to achieve the course objectives, based on their own willingness, motivation and metacognition. The cyclical phase model was presented in 2000 with the processes divided into each phase in a separated table (Zimmerman, 2000). In 2003, the processes were included in the figure (Zimmerman & Campillo, 2003) and in 2009 the model was revised (Zimmerman & Moylan, 2009) including more processes in the performance phase and defining in more details all the processes and how they interact.

According to Zimmerman and Moylan (2009), the self-regulatory cycle starts with the Forethought-phase with task analysis where this is fragmented into smaller pieces and the personal strategiesfor the performance are chosen based on previous knowledge and or experience (Winne, 2001). This is thephase in which the goals and strategic planning are established, which are key conditions for self-regulation to occur (Figure 1).

Students approach the task, analyzing it, assessing their capacity to perform it with success and establishing goals and plans regarding how to complete it. The task interest and the goal orientation play a crucial role to achieve adequate planning and performing the task appropriately. In this phase the students do two main activities. First, they analyze what the task characteristics are by creating a first representation of how it should be performed. Second, they analyze the value the task has for them; this conditions their motivation and effort, and therefore, the attention they will pay during the performance; in other words, their activation of self-regulatory strategies.

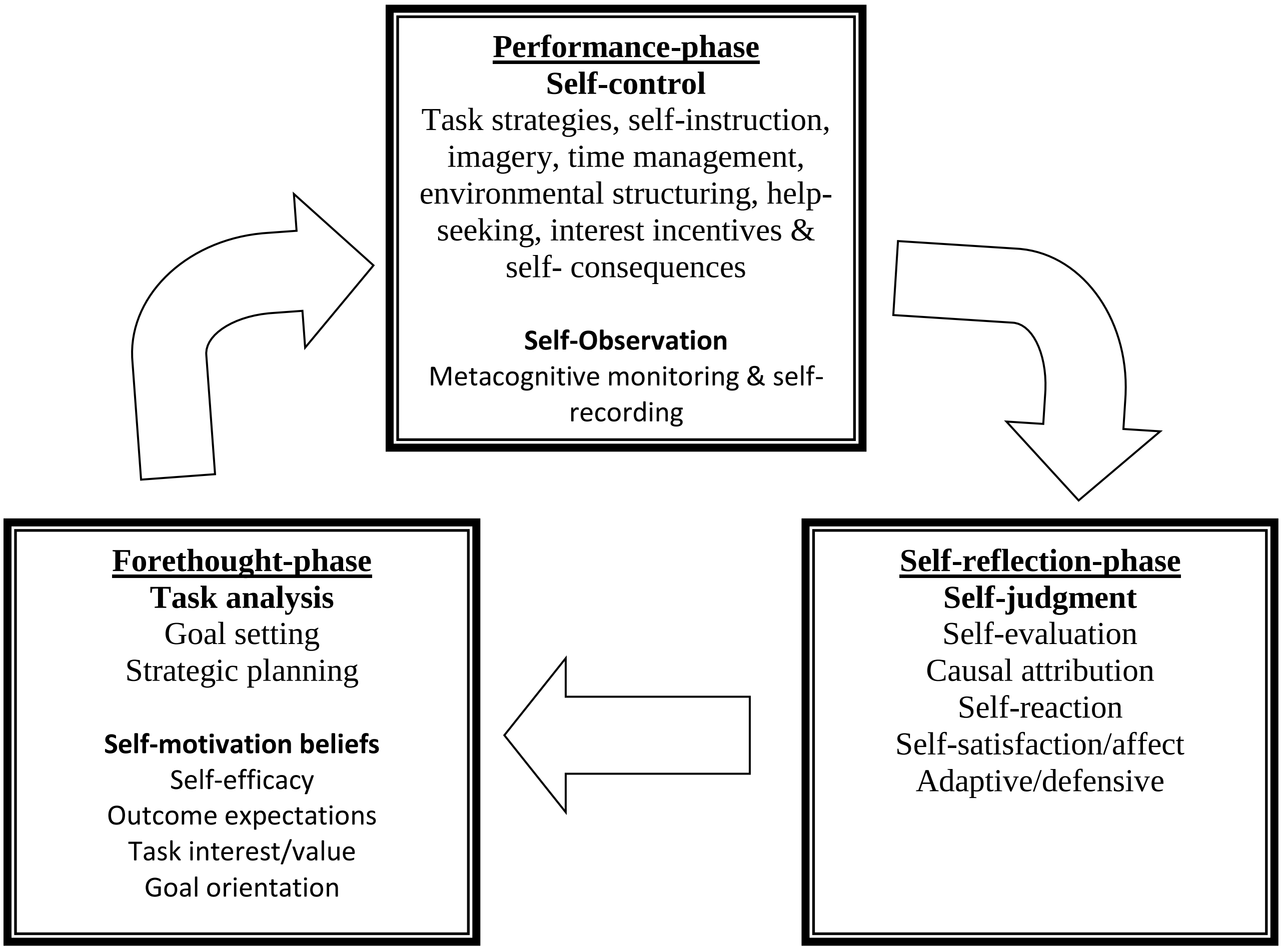

Figure 1. Phases and process of self-regulation (Zimmerman and Moylan, 2009)

In the performance phase, it is important that the students keep their concentration and that they use appropriate learning strategies for two reasons. First, so their motivation does not decrease, second to keep track of their progress towards their goals. Both implicate different actions and processes that are different depending on the self-regulation model used. According to Zimmerman and Moylan (2009), the two main processes during the performance are self-observation and self-control, and in order for them to work successfully a number of strategies can be followed.

The last stage which is the self-reflection phase, students judge their work and formulate reasons for their results. While justifying theirsuccess or failure, they experience positive or negative emotions depending on their attribution style. These emotions will influence their motivation and regulation in the future.

Achievement in Chemistry

Chemistry is one of the major branches of science. A poor chemistry foundation at the secondary school will jeopardize any future effort to enhance achievement in the subject. The study of chemistry at the secondary school level helps students in developing basic skills, knowledge and competence required for problem solving in their environment. According to Ohodo (2005) chemistry contributes to the attainment of the aims of education and specifically helps individuals to develop effective process skills, critical thinking and competences required for dealing with observation, classification, measurement, counting numbers, recording, communication, prediction, hypothesis, inference, experimentation, interpretation of data, research, controlling variable and generalization etc.

One factoraffecting achievement in chemistry is the ability of the students to regulate their learning.The importance of SRL in predicting higher academic achievement has been well recognized in many Western studies (e.g., Pintrich & De Groot, 1990; Pressley, 1986; Zimmerman, 1990; Zimmerman & Martinez-Pons, 1990). This had supported the study conducted by Sui-ChuHo (2004) that SRL is positively related to academic achievements in reading, mathematics, and science domains in Hong Kong students. According to Baluyot and Espinosa (2014), self-regulation is significantly correlated to students' achievement. Similarly, Inan (2013) found out that there is a positive and significant correlation between self-regulated learning strategies and academic success. Among the learning strategies identified were motivation and action to learning, planning and goal setting, strategies for learning and assessment. Moreover, Lindner and Harris (1992) and Vrugt and Oort (2007) conducted research in higher education settings and found a correlation between academic success and self-regulated learning strategies.Students with better self-regulation skills typically learn more with less effort and report higher levels of academic satisfaction (Pintrich, 2000; Zimmerman, 2000).

Furthermore, Gakhar (2005) in her study found positive significantly correlation in the study skills and academic achievement of students. As well as Gurubasappa (2009) found out that there was high significant correlation between academic achievement with intelligence and self concept.

Adeniyi et al. (2008) studied five variables as predictor of academic achievement among school-going adolescents and found that the causative factors of academic performance as resident in the family, school, society and government were not significant in predicting the secondary students' performance in two major subjects (English and Mathematics). But there was significant relationship between the causative factors resident in the child and the academic performance of the school.

Kirk (2000) investigated the relationship of cognitive style to achievement in chemistry. Results indicated that field independence has significantly correlated with academic achievement in chemistry.

Conceptual Framework

Based on the review of literature, Figure 2 shows the conceptual framework of the study that represents how the Grade 9 Science Learner's Material and Traditional Learning Material will affect the students' self-regulation and achievement in Chemistry.

The purpose of the study is to compare students exposed to Grade 9 LM and students exposed to Traditional LM in terms of their effect on students' self-regulation and achievement in Chemistry. The seven processes involved in self-regulation are informational input, self-evaluation, instigation to change triggered by perceptions of discrepancy, search for ways to reduce discrepancy, planning for change, implementation of behaviour change, and evaluation of progress towards a goal. According to Miller & Brown (1991) these processes were indicated as *receiving, evaluating, triggering, searching, formulating, implementing* and *assessing* by them. Brown (1998) argues that deficits in any of these self-regulatory processes can contribute to disorders of behaviour regulation, such as addictive disorders. Furthermore, this elaborated model identifies appropriate intervention targets corresponding to specific deficits.

Self-regulation is an important interdisciplinary competence that leads to improved learning and help individuals cope with the challenges of life-long learning in a knowledge society (OECD, 2012). It is widely accepted that SRL has a crucial role in school achievement. Research shows that increases in self-regulation result in higher student learning and achievement.

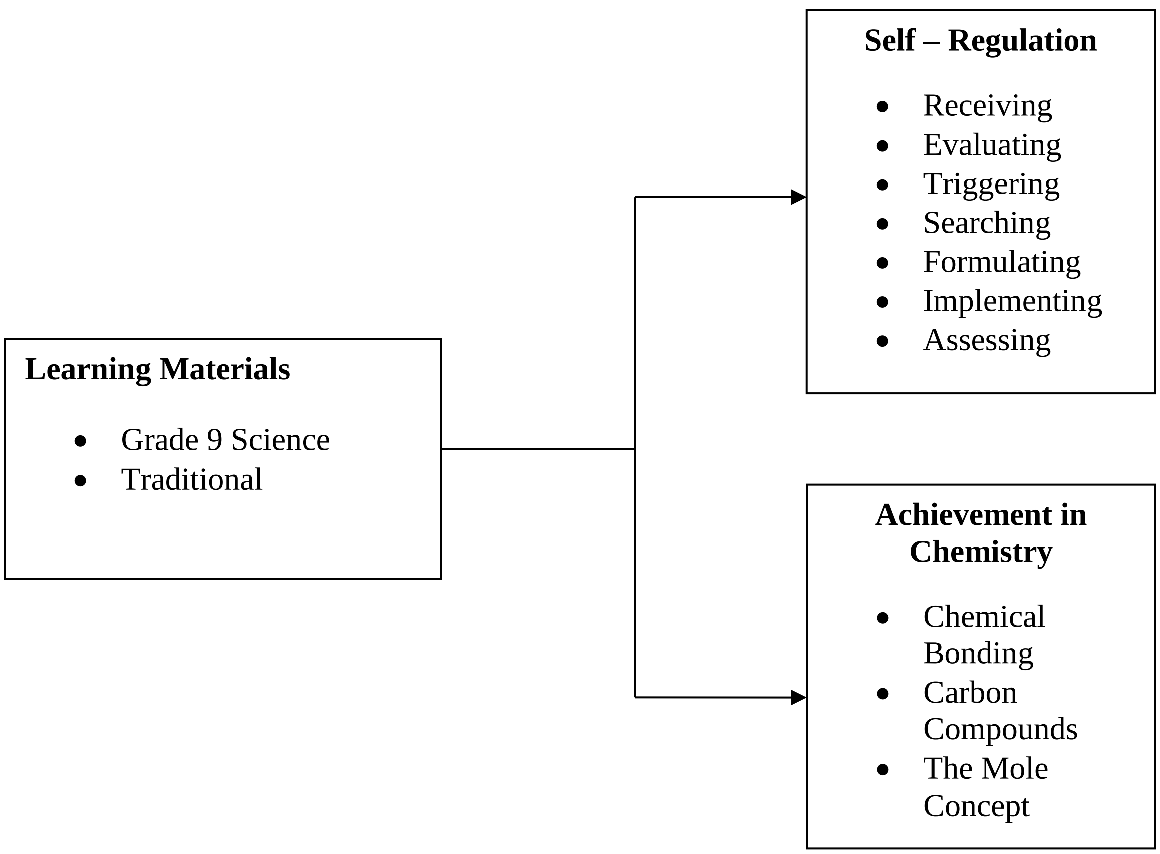

Figure 2. Conceptual Framework of the Study

Research Hypotheses

1. Students exposed to Grade 9 Science Learner's Material have the same self-regulation in Chemistry as to those who were exposed to Traditional Materials.

2. Students exposed to Grade 9 Science Learner's Material have the same achievement in Chemistry as to those who were exposed to Traditional Materials.
3. None of the self-regulated learning domains is evident among Grade 9 Science Learner's Material and Traditional Materials.

Methods

Research Design

This study utilized pretest-posttest quasi-experimental research design to test the effectiveness of Grade 9 Science Learner's Material on students' self-regulation and achievement in Chemistry compared to the Traditional Material. It also used reflective journal to elicit evidences of the domains of self-regulated learning. The figure below shows the research design.

O_1	O_2	X_1	O_1	O_2
O_1	O_2	X_2	O_1	O_2

Figure 3. Research design

where:

X_1- Grade 9 Science Learner's Material

X_2 - Traditional Material

O_1- Self-Regulation Questionnaire, which was administered before and after the intervention

O_2 - Chemistry Achievement Test, which was administered before and after the intervention

The Sample

For this study, purposive sampling was used to test the effectiveness of the Grade 9 Learner's Material on student's self-regulation and achievement in Chemistry. It involved seventy Grade 9 students of Northville High School. The study was conducted on the second grading period specifically from the month of August to second week of October school year 2014-2015. The assignment of the learning material to the class was based on a coin toss. One Grade 9 section was assigned as the Traditional Material Group, while the other section was assigned as the Grade 9 Science Learner's Material Group.

Research Instruments

There were two instruments used in the study - the Self-Regulation Questionnaire (SRQ) and the Chemistry Achievement Test (CAT).

Self-Regulation Questionnaire

The Self-Regulation Questionnaire (SRQ) was developed by Brown, Miller and Lawendowski in 1999 as an attempt to assess self-regulatory processes namely; *receiving* relevant information, *evaluating* the information and comparing it to norms, *triggering* change, *searching* for options, *formulating* a plan, *implementing* the plan and *assessing* the plan's effectiveness which then recycles to steps 1 and 2. Items were developed to mark each of the seven sub-processes of the Miller and Brown (1991) model, forming seven rationally-derived subscales of the SRQ.

The SRQ has sixty-three items. See Appendix D.It is a five-point rating scale which ranges from 5-Strongly Agree, 4-Agree, 3-Uncertain or Unsure, 2-Disagree and 1-Strongly Disagree.The development ofthe instrument was supported in part by Grant #P183C80007 from the U.S. Department of Education, Fund for the Improvement of Post-Secondary Education. The SRQ is in the public domain and may be freely used, adapted and reproduced without special permission. Its reliability was calculated to be 0.94 by Aubrey, Brown and Miller in 1994.

Chemistry Achievement Test

To measure the student's Chemistry Achievement, the researcher tailored-fit a 50-item achievement test, which focuses on the concepts in Chemical Bonding, Carbon Compounds and Mole Concept from the grade 9 Science learner's material which was provided by the DepEd to all Grade 9 science teachers. The Table of Specification was presented for the test development.

The test is multiple choice and follows the guidelines on how to assess the Grade 9 students. It was composed of four levels of assessment namely, knowledge, process, understanding and product or performance. The experts in the field validated the assignment of questions based on the four levels of assessment which included the science supervisor of the division of City of San Fernando, Pampanga and two master teachers from Pampanga High School.

The test was pilot tested with forty-five Fourth Year students who were enrolled at Pampanga High School. Scores from pilot test weresubjected to item analysis and reliability coefficient Cronbach alpha. The computed Cronbach alpha was 0.748.

After the difficulty of an item and index of discrimination were sought, then reconstruction of the test was done. Fifteen items were discarded. The final draft was composed of thirty-five items with four choices which covered the concepts in Chemical Bonding, Carbon Compounds and Mole Concept.

Instructional Materials

Students were instruction in the same content using two different methods. One group was instructed using the new Grade 9 materials while the other used the old materials.

Grade 9 Science Learner's Material

The Grade 9 Science Learner's Material was utilized as intervention material in the study. It is composed of four modules with activities on Chemical bonding, Carbon compounds and Mole concept. The activities were developed, reviewed and encoded by experts in the field fromboth private and public school.The said activities are in line with the features of the reform-based curriculum., Edwin Uy, the DepEd's program coordinator, told that time constraint has forced the distribution of learning packages instead of textbooks in public schools to get the government's enhanced basic education program or K to 12, up and running (Mangunay,2013). Uy also added that the packages were "more cost-effective" in ensuring that the materials conform to new standards and were “faster” to publish. Furthermore, it would take publishers a year and a half to two years to publish textbooks and that this could not be an option for the department.

The Grade 9 Science Learner’s Material on Chemistry has four (4) modules. Module 1is on Electronic Structure of Matter, module 2is on Chemical Bonding, module 3 is on TheCarbon Compounds and module 4 What’s in a Mole?

Module 1: Electronic Structure of Matter

One of the activities under module 1 is the *Flame Test*. Students needed to determine the characteristics colors that metal salts emit and relate the colors emitted by metal salts to the structure of the atom by performing an experiment. Five metal saltscalcium chloride ($CaCl_2$), sodium chloride (NaCl), copper (II) sulfate ($CuSO_4$), potassium chloride (KCl), and boric acid (H_3BO_3) were tested using 3M of HCl and 95% of ethanol. Students are expected to formulate concepts and infer ideas, manipulate the materials, and distinguish the colors emitted by a certain metal salt.

The second activity is *Predicting the Probable Location of an Electron*. Students used an analogy to understand the interpretation of Schrodinger’s treatment of the atom and describe how it is likely to find the electrons in an atom by probability. To do, this, students drew a dot on the center of the sheet of paper or folder and make five concentric circles around the dot so that the radius of each circle was1.0, cm, 3cm, 5cm, 7cm and 9 cm. The teacher demonstrated on how the activity was done. Students interpreted illustrations, computed for the area of circles, number of dots, and percent probability of finding the dots and related it in probability of finding electrons in an atom.

The third and last activity under the Electronic Structure of Matter is the *Electron Configuration*. Students needed to write the electron configuration of the elements in the third period, determine the pattern of filling the orbitals based on the given distribution of the first ten (10) elements and devise rule in filling up the orbitals.

Module 2: Chemical Bonding

The first activity is *Mapping the Periodic Table*. Students identified the number of valence electrons of atoms and compared the electronegativity values of metals and non-metals. A template of the periodic table of elements was given to students to locate and color the area of metals, non metals and noble gases. Students also needed to observe the number that corresponds to the valence electrons, electronegativity and ionization energy of metals and non-metals.

The second activity is *Lewis Symbol*. In this part, the students needed to write the Lewissymbol of the representative elements and showed the relationship among the number of valence electrons, electronegativity and ionization energy.

The third activity is *Bonding by Transfer of Electrons*. Students illustrated how an ionic bond is formed and showed how ions are formed. To do this, students were tasked to choose five (5) combinations that will result to ionic bonding.

The fourth activity is *Bonding by Sharing of Electrons*. Students were asked to explain how covalent bonding takes place and illustrate the sharing of electrons.

The fifth activity is *Bonding Among Metals*. Students made a model of a metallic bond and related the properties of metals to the kind of bond they are made of. To do this, students were asked to draw a representation of a metallic bond. This is in order to find out their mental models about metallic bonding.

The sixth and last activity is *Differences between Ionic and Covalent Compounds*. Students needed to recognize ionic and covalent compound based on their physical properties. Compounds such as sugar (sucrose), paraffin wax (candle wax), salt (sodium chloride) and vetsin (monosodium glutamate) were used. Students tested the conductivity of these compounds with and without water.

Module 3: The Carbon Compounds

The first activity is *Organic Compounds: Are they Useful?* Students needed to recognize the uses of common organic compounds. Students identified whether a certain product is a beverage, food, antiseptic, fuel or cleanser based from the posted pictures on the board.

The second activity is *Properties of Common Organic Compounds*. Students needed to observe the properties of the common organic compounds and related these properties to their uses. Materials included kerosene, lubricating oil, diesel oil and ethyl alcohol which students tested for viscosity, volatility and flammability of each material.

The third activity is *The Hydrocarbons*. Students needed to recognize common kinds of alkanes, alkenes and alkynes and their uses, identify the types of bonds they formed and relate their structures to their properties.Students were given a table of hydrocarbons with their names, phases, structural, condensed structural formula and boiling point.

The fourth activity is *Which bananas will ripen faster?* Students investigated how a common organic compound namely ethylene can ripen fruits faster than the natural way. The experiment madeuse of a chemical compound called calcium carbide, CaC_2 (kalburo) wrapped in a sheet of newspaper and placed at the bottom of one shoe box containing three unripe bananas. The other shoe box contained also three unripe bananas but without calcium carbide. The two shoe boxes were left for forty eight hours.

The fifth activity is *Alcohols and Their Uses.* Students needed to recognize the uses of common alcohols identify similarities in the structures of different kinds of alcohols and relate these similarities to the common properties they have. Pictures or labels of different products containing ethyl alcohol, isopropyl alcohol, ethyl alcohol and denatured alcohol were used as sources of information. Students wrote on the table of data the name of the product, name of alcohol/s present in the product, percent (%) or amount of alcohol in the product and their uses.

The sixth and last activity is *What is between Acetone and Formalin?* Students gave the common uses of acetone and formalin and relate their structures to the carbonyl compounds where they belong. To do this, illustrations of the structures of acetone and formaldehyde were used and students worked in groups to share their ideas with one another.

Module 4: What's in a Mole?

The first activity is *Counting by Getting the Mass of an Object*. Students needed to measure the mass of an object, record the mass with the correct number of significant figures and relate the mass of the object to the number of pieces per item.Students measured and recorded the mass of twenty five (25) pieces paper clip using a platform balance and a handful of paperclips and measured their masses.

The second activity is *Total Count Vs. Mass.* Students measured the mass of a given number of objects, recorded the mass with the correct number of significant figures and converted the number of items to its equivalent mass in grams or vice versa using the equivalents taken from the result of the activity. The idea was to make the students fully understand that even though materials have the same number, different types of materials have different masses.

The third activity is *The Mass of One Mole of a Substance*. Students computed for the molar mass of common substances. Students made use of periodic table of elements to get the mass of one atom.

The fourth activity is *The Relationships Among Number of Moles, Mass and Number of Particles*. Students described the relationships among the number of moles, mass and number of particles. In this activity students realized that in a quantitative experiment, the use of a tablespoon and other such measuring devices to determine the quality of different substances are not always advisable because it may yield inaccurate results. Students also needed to get the mass and compute for the number of moles and number of particles of a substance.

The fifth activity is *The Chemist's Mole*. Students applied the mole concept in completing the given set of data.Student completed the table of a given substance by identifying what kind of particle is the given substance, computed for the molar mass, mass, number of moles and number of particles.

The sixth activity is *Mole Map.* Students prepared a concept map on the mole concept. Students completed the concept map with the appropriate terms. Accomplishing the concept map means students have understood their lessons.

The seventh and last activity is *It's Grocery Time!* Students applied the concept of percentage composition in choosing grocery items and realize that the amount of substance intake can be monitored with the use of percentage composition. Students got three samples of containers or package of grocery items such as canned goods, snacks and beverages, made a research on the their chemical formula and computed for the percentage composition of each substance.

Traditional Material

The activities under the Traditional Material were used by the Traditional Group. These were the activities prepared and used in teaching prior to the implementation of the K to 12 reform.

Under the Electronic Structure of Matter, there are three activities. These are the*Flame test, Finding Electrons and Electron Configuration.*

In the first activity the students were asked to answer the given questions and formulate concepts regarding the video presentation on flame test.This was followed by the next activity where students filledthe table with the correct letter of subshell, number of electrons per energy level and drew the electron orbital diagram of a certain atom. In the last activity the students wrote the electron configuration of the atoms given in the previous activity.

In Chemical Bonding, there are six activities. These are the *Periodic Table Activity, Lewis Symbol, Atomic Dating, Covalent Bonding, Metallic Bonding and Ionic and Covalent Compounds.*

In first is the*Periodic Table Activity*, the students observed and identified the main features of the periodic table of elements. The second is the *Lewis symbol* where students used Lewis dot structures to show the valence electrons of an element. Third is *Atomic Dating* where students played the role of being a matchmaker and made each atom stable by determining how many valence electrons each element needs and finding a partner that will complete the valence energy level. Fourth is *Covalent Bonding*, students illustrated the chemical bond and identified the type of bond of a certain compound. Fifth is *Metallic Bonding*, students observed the animation that represents the metallic bonding, sketched and a diagram of the animation and explained the diagram. The sixth and last activity is *Ionic and Covalent Bond*, students made a research on the properties of ionic and covalent bond.

In The Carbon Compounds, there are six activities. These are the *Uses of Common Organic Compounds, Properties of Organic Compounds, The Hydrocarbons, Uses of Some Hydrocarbons, Uses of Common Alcohols and Carbonyl Compounds.*

The first activity is the *Uses of Common Organic Compounds.* Students made a research on the uses of the common organic compounds found at home. Second is the *Properties of Organic Compounds,* where students identified and analyzed some of the common organic compounds they had in the previous activity. Third is *The Hydrocarbons*, students presented and discussed the three groups of hydrocarbons. Fourth activity is the *Uses of Some Hydrocarbons* where students explained uses of some hydrocarbons. Fifth is the *Uses of Common Alcohols.* Students identified and classified the uses of common alcohols. The sixth and last activity is the *Carbonyl Compounds* where students made a research about carbonyl compounds, its properties and uses.

For the last module which is the Mole Concept, there are five activities. These are the *Mole Activity, Molar Mass, Molar Mass Race, Mole, Mass and Particles and Percentage Composition*.

The first activity is about *Mole*. Students identified whether a particle is an atom, molecules or formula unit and analyzed how many moles are there in a given particle. Second is the *Molar Mass* where students computed the molar mass of a compound. Third is the *Molar*

Mass Race, students gave the correct chemical formula of a compound and computed its molar mass. Fourth is *Mole, Mass and Particles*, students solved problems to show their relationships. The fifth and last activity is the *Percentage Composition*; students also solved problems involving percentage composition.

A semi-detailed lesson plan on Flame test for Grade 9 Science Learner's Material and Traditional Material respectively presented in Table 1.

Table 1

Semi-Detailed Lesson Plan on Flame test

	Grade 9 Science LM	**Traditional M**
Objectives	• Determine the characteristic colors that metal salts melt; and • relate the colors emitted by metal salts to the structure of the atom	• Determine the characteristic colors that metal salts melt; and • relate the colors emitted by metal salts to the structure of the atom
Subject Lesson Materials	Electronic Structure of Matter Flame test 0.50 g of each of the following Metal salts: Calcium chloride 6 pcs watch glass Sodium chloride1 pc dropper Copper (II) sulfate safety matches Potassium chloride Boric Acid 1 pc 10 – mL graduated 100 mL 95 % Ethanol (ethyl alcohol) 100 mL 3 M hydrochloric acid	Electronic Structure of Matter Flame test Laptop Speaker Lcd projector widescreen Videos on flame test
Reference/s	Grade 9 Learner's Material (DepEd)	https://www.youtube.com/watch?v=gI3TbQc0Uwg https://www.youtube.com/watch?v=WoxQij8QTH8
Procedure	1) Pre-lab discussion on the earlier concepts of the atomic structure. 2) Give instructions on how the activity will be performed. Write the safety precautionary measures on the board. 3) Group the students and let them do the activity. 4) Presentation of students' outputs and processing the activity. 5) Post activity discussion on the students' observation	1) Recall the discussion on the earlier concepts of the atomic structure 2) Introduce the topic 3) Ask motive question Can particles of atom produce light? How? 4) Present the videos and ask students to identify the elements and distinguish the colors they emitted. 5) Discuss the lesson using Socratic method

Evaluation	Students' outputs/ reports on the activity Journal Writing	Short quiz and Journal Writing

Data Collection Procedure

Two intact groups were utilized in the study. The first group used the Grade 9 Science Learner's Material, while the second group used the Traditional Material. The researcher handled both classes. They only differed in terms of learning material.

Prior to the treatment, the Chemistry achievement pretest and self-regulation questionnaire were given to both groups. Pretest and posttest on chemical bonding, carbon compounds and mole concept were also conducted before and after each module.

After each activity, students were asked to make reflective journal on how did they accomplished the task. The Chemistry achievement posttest and self-regulation questionnaire were given simultaneously on both groups.

Findings and Discussions

Grade 9 Science Learner's Material and Self-Regulated Learning

The pretest and posttest ratings on self-regulation between two groups were analyzed using two-tailed and one-tailedMann-Whitney *U*test. Mann-Whitney U test is a non-parametric test that can be used in place of an unpaired t-test. There are seven domains associated on the Self-Regulation Questionnaire namely:(1) receiving, (2) evaluating, (3) triggering, (4) searching, (5) formulating, (6) implementing and (7) assessing.

Initial Comparability on Self-Regulation

A two-tailed Mann-Whitney *U* test was utilized to compare the pretest ratings of Grade 9 Science Learner's Material and Traditional Material group on the Self-Regulation Questionnaire (SRQ) as shown in Table 2. The results showed that there is no significant difference between the pretest ratings of the Grade 9 Science Learner's Material group with the mean rank of 35.97 and the Traditional Material group with the mean rank of 35.03; $U = 596$, $p = 0.846$. This result suggested that both groups were not totally different from each other prior to the Grade 9 Science Learner's Material and the Traditional Material.

Table 2
Independent Samples Mann-Whitney U test of SRLPretest

Learning Materials	Mean	*U*	*p*	Remark
a. Grade 9 Science	35.97			
		596	0.846	Not Significant
b. Traditional	35.03			

$*N^{a,b} = 35$, $*p < 0.05$

Table 3 shows the pretest ratings of the Grade 9 Science Learner's Material and Traditional Material on the four domains of self-regulation. These were the *receiving,evaluating*, *triggering* and *searching*. While Table 3.1 shows the pretest ratings on the three remaining domains. These were the *formulating, implementing* and *assessing*. The pretest ratings were compared and utilized using a two-tailed Mann-Whitney *U* test. The results showed that there is no significant difference in the pretest scores of the Grade 9 Science Learner's Material and Traditional Material. This showed that both groups were not totally different from each other.

Table 3
Independent Samples Mann-Whitney U Test on Seven domains of SRLPretest

Learning Materials	Receiving			Evaluating			Triggering			Searching		
	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*
a. Grade 9 Science	37.61	538.5	0.383	31.57	475	0.105	34.87	590.5	0.795	38.47	508.5	0.221
b. Traditional	33.39			39.43			36.13			32.53		

$*N^{a,b} = 35$, $*p < 0.05$

Table 3.1
Independent Samples Mann-Whitney U Test on Seven domains of SRLPretest (continuation)

Learning Materials	Formulating			Implementing			Assessing		
	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*
a. Grade 9 Science	36.4	581	0.71	33.53	543.5	0.417	35.39	608.5	0.962
b. Traditional	34.6			37.47			35.61		

$*N^{a,b} = 35$, $*p < 0.05$

Effects of Grade 9 Science Learner's Material on SRL

A one-tailed Mann-Whitney *U* test for two independent samples was conducted to compare the posttest ratings of Grade 9 Science Learner's Material and Traditional Material group. This is because the researcher focused only as to whether the Grade 9 Science Learner's Material is effective in enhancing students' self-regulation. Table 4 shows the results that there is a significant difference in the posttest ratings of Grade 9 Science Learner's Material group with the mean rank of 40.39 and Traditional Material group with the mean rank of 30.61; $U = 441.5$, $p = 0.0225$. This showed that the self-regulation of students exposed to Grade 9 Science Learner's Material was enhanced compared to students who were exposed to Traditional Material.

Table 4

Independent Samples Mann-Whitney U test of SRL Posttest

Learning Materials	Mean	*U*	*p*	Remark
a. Grade 9 Science	40.39	441.5	0.0225	Significant
b. Traditional	30.61			

$^*N^{a,b} = 35$, $^*p < 0.05$

Table 5 shows the posttest ratings of the Grade 9 Science Learner's Material and Traditional Material on the four domains of self-regulation. These were the *receiving,evaluating, triggering* and *searching*. While Table 5.1 shows the posttest ratings on the remaining three domains. These were the *formulating, implementing* and *assessing*. The posttest ratings were compared and utilized using a one-tailed Mann-Whitney *U*test. The results showed that there is a significant difference in the *triggering, searching* and *formulating* domains of self-regulation posttest ratings of the Grade 9 Science Learner's Material groupcompared to the Traditional Material group. However for *receiving, evaluating,implementing* and *assessing*there is no significant difference.

Table 5

Independent Samples Mann-Whitney U Test on Seven domains of SRL Posttest

Learning Materials	Receiving			Evaluating			Triggering			Searching		
	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*
a. Grade 9 Science	39.26	481	0.0605	38.11	521	0.1405	40.43	440	0.021	39.63	468	0.044
b. Traditional	31.74			32.89			30.57			31.37		

$^*N^{a,b} = 35$, $^*p < 0.05$

Table 5.1

Independent Samples Mann-Whitney U Test on Seven subscales of SRL Posttest (continuation)

Learning Materials	Formulating			Implementing			Assessing		
	Mean	*U*	*p*	Mean	*U*	*p*	Mean	*U*	*p*
a. Grade 9 Science	40.66	432	0.0165	36.73	569.5	0.306	39.34	478	0.0565
b. Traditional	30.34			34.27			31.66		

$^*N^{a,b} = 35$, $^*p < 0.05$

This is because activities under Grade 9 Science Learner's Material provided more opportunities for the students to use as many skills as possible. In the study conducted by Mattheis and Nakayama (1988), hands-on activities increase skill proficiency in processes of science, especially laboratory skill and specific science process skills, such as graphing and interpreting data. Also, Turpin and Cage (2004) found out that participants using integrated, activity-based science curriculum had significantly higher scores in the areas of science achievement and science process skills when compared to students using a traditional science curriculum.

Overall, the Grade 9 Science Learner's Material enhanced three (3) out of seven (7) domains of self-regulation: triggering, searching and formulating as compare to the Traditional Material group. This can be seen on the students' journal where students' elicited self-regulatory process.

The statements below came from Grade 9 Science Learner's Material where students clearly manifested the *triggering, searching* and *formulating* domains of self-regulation.

Triggering and Searching

One of the prompt questions used to elicit the triggering and searching domains of self-regulation was:

"If you were to perform the activity again, will you change it? If Yes, what? If No, why?"

The students answered:

"Yes, it would be better if there would be a representation of an atom to show their bond formation."

"Yes, because I don't easily get the idea behind the sharing of electrons."

"Yes, because there are some concepts that I don't understand."

"Yes, Kasi po hindi ko po siya gaanong naiintindihan dahil po walang actual na ginawa".
(Because, I found it bit difficult since there was no actual manipulation of atoms.")

"Pwedeng Yes or No kase walang actual."(It can be Yes or No because there was no actual manipulation of atoms.)

On the other hand, statements below came from Traditional Material Group.

The students answered:

"No, because I saw the different colors of metal salts and I am amazed".

" No, because my teacher do discussion carefully to the lesson and listening to all classmate."
(No, because my teacher discussed the lesson carefully. All my classmates listen attentively.)

"No, because careful discussion me and so very important to answer the activity all".
(No, because my teacher discussed it carefully. What important is I was able to answer the activity.)

"No, I think I just need to focus and concentrate.

"Yes, because the lesson is not careful to me is more important to give more examples.
(Yes, because the lesson is not clear to me. It is important to give more examples.)

Based from the statements of the students, the Grade 9 Science Learner's Material have helped the students to enhance their skills. This is because the activities were of an inquiry-based learning approach. Inquiry learning is a student-centered approach that allows the student to have more control over their "knowledge-getting". It arouses students' curiosities and motivates students to continue to seek until they find answers. This is supported by Slavin (2006).According to Harlen (2004) inquiry learning in science develops the perception skills of students because it allows them to understand the natural phenomena and the world by using their cognitive and physical skills. It is suggested that this kind of learning shows students the nature of scientific studies and the ways learning is realized. Thus, it develops their discovery skills (National Research Council [NRC], 2004).

Also, Khan and Iqbal (2011)studied the effectiveness of Inquiry-Based Teaching Approach (IBT) on the development of scientific processes and skills among ninth grade secondary schools students of biology. The findings of the study affirmed the impact of Inquiry-Based Teaching Approach (IBT) on the students' learning outcomes in that the mean gains of the students in the treatment groups were significantly higher than that of the students in the control groups. Also, the results indicated that the mean difference between the experimental and the control groups were statistically significant in favor of the treatment group. Similarly, Sola and Ojo (2007) showed that inquiry models of teaching were very effective in enhancing student achievement and skill development. They reported that student achievement scores and analytical skills were either raised or greatly enhanced.

Formulating

Another prompt question was asked to the students to show on how they can formulate a plan in completing the task. The question was:

"How did you answer/do your activity?"

The students answered in Grade 9 Science LM :
"I prepared the materials then I listening to instruction and we experiment with my classmate and then after the experiment I answer the activity." (I prepare the materials and listen to my teacher's instruction. We perform the activity then answer it.)

"I *listen to my instructions of my teacher."* (I listen to the instructions of my teacher.)
"*I prepare my periodic table."*
"I can find the valence electron in each element in the periodic table." (I look for the valence electron of each element given in the periodic table.)
"Then *I draw or write the dots in the elements and I answer the guide questions."*
"*I read the instruction."*
"I solve this with my scientific calculator."
"I do my best to solve this in my own."

"I ready a 2Box. The 1 box is A, the second box is B. Then I put a newspaper to the box and then tape after that I put the 3 banana to the box and 3 banana to the box B." (I prepare 2 boxes and label it Box A and Box B. I put a newspaper in each box and 3 bananas. Then I cover the boxes with masking tape.)

"I listening to the instruction and I prepared the materials and we experiment with my groupmates and then I answer the activities about the properties of common organic compound." (I listen to the instructions of my teacher. Then with my group mates, we prepare the materials, perform the experiment and answer the guide questions about the properties of common organic compound.)

The students answered in Traditional LM:

"Because I am listening to my teacher and look for video to give the answer in the activity".

(Because I am listening to my teacher and watch the video so that I can answer the activity.)

"I look on my lecture and listen to Ma'am Roselle".

"I copy and listen to my teacher".

"I listen to my teacher's discussion".

"Im going to the library and read book of chemistry".
(I went to the library and read some books in chemistry.)

The statements from the students show that both materials allow the students to actively participate in the learning process. However, the Grade 9 Science Learner's Material provided more opportunities for the students to regulate their learning such as formulating ideas and questions, investigating to find answers, building new understandings, meanings and knowledge, and communicating their learning's to others. This corroborated the study of Cennamo, Ross, and Rogers (1999) who reported that the activities and resources provided to learners enabled them to obtain skills needed to become self-regulated learners.

In addition, the activities allow the students to think and use strategies in order to answer and complete the task. Learning strategies are very important in an academic development because it facilitates learning and enhances performance. Similarly, according to Oxford and Nyikos (1989: 291), "the use of appropriate learning strategies enables students to take responsibility for their own learning by enhancing learner autonomy, independence and self direction".

Grade 9 Science Learner's Material and Achievement in Chemistry

The pretest scores on Achievement Test in Chemistry, Chemical Bonding, Carbon Compounds and Mole Concepts were subjected to two-tailed independent samples *t*-test to establish the initial comparability of the Grade 9 Science Learner's Material and Traditional Material. Then the posttest scores were analyzed for group differences using a one-tailed independent samples *t*-test.The independent t-test is a parametric test and used to determine whether there is a statistically significant difference between the means of two independent samples.

Initial Comparability on Achievement in Chemistry

A two-tailed independent samples *t*-test was conducted to compare the pretest scores of Grade 9 Science Learner's Material and Traditional Material on the Achievement in Chemistry as shown in the Table 6. Both groups have thirty five students. The results showed that there is no significant difference between the pretest scores of Grade 9 Science Learner's Material (M = 9.54, SD = 2.67) and the Traditional Material (M= 8.71, SD = 2.22); t (68) = -1.412, p = 0.163. This result suggested that both groups were not totally different from each other.

Table 6
Independent Samples t-Test on Achievement Test in Chemistry Pretest

Learning Materials	Mean	SD	*t*	df	*p*	Remark
a. Grade 9 Science	9.54	2.67				
			-1.412	68	0.163	Not Significant
b. Traditional	8.71	2.22				

*N[a,b]= 35, *p < 0.05

Table 7 shows the pretest scores of Grade 9 Science Learner's Material on the chemical bonding, carbon compounds and mole concept. Both groups have thirty five students. The results showed that there is a significant difference between pretest scores of the Grade 9 Science Learner's Material in the Chemical Bonding (M = 10.03, SD = 3.60) and Traditional Material (M = 7.31, SD = 2.29); t (68) = -3.765, p = .000: Grade 9 Science Learner's Material in Carbon Compounds (M = 6.94, SD = 1.91) and Traditional Material (M= 5.69, SD = 1.98); t (68) = -2.703, p = .009.

On the other hand the results on the pretest scores of Grade 9 Science Learner's Material in Mole Concept (M= 3.97, SD = 1.74) and Traditional Material (M= 4.4, SD = 1.91); t (68) = .980, p = .33. This result showed that there is no significant difference between the pretest scores of both groups in mole concept.

Table 7
Independent Samples t-Test on Chemical Bonding, Carbon Compounds and Mole ConceptPretest

Learning Materials	Chemical Bonding				Carbon Compounds				Mole Concept			
	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*
a. Grade 9 Science	10.03	3.60	-3.765	0.000	6.94	1.91	-2.703	0.009	3.97	1.74	0.98	0.33
b. Traditional	7.31	2.29			5.69	1.98			4.4	1.91		

*N[a,b]= 35, *p < 0.05

Effects of Grade 9 Science Learner's Material on Achievement Test in Chemistry

A one-tailed independent samples *t*-test was conducted to compare the posttest scores of Grade 9 Science Learner's Material and Traditional Material. Table 8 shows that there is no significant difference in the posttest mean scores on the achievement test in Chemistry of Grade 9 Science Learner's Material (M = 17.63, SD = 3.14) and Traditional Material (M = 17.4, SD = 3.26), t (68) = -0.229, p = 0.383. This result showed that the knowledge on the achievement in Chemistry of students who were exposed using Grade 9 Science Learner's Material was the same as to those who were exposed to the Traditional Material.

Table 8

Independent Samples t-Test on Achievement Test in Chemistry Posttest

Learning Materials	Mean	SD	*t*	df	*p*	Remark
a. Grade 9 Science	17.63	3.14				
			-0.299	68	0.383	Not Significant
b. Traditional	17.4	3.26				

$^*N^{a,b}$= 35, $^*p$< 0.05

Table 9 shows that there is a significant difference in the posttest mean scores in the chemical bonding, carbon compounds and mole concept of Grade 9 Science Learner's Material. The results showed that the knowledge on the topics in chemistry of students who were exposed using the Grade 9 Science Learner's Material was enhanced compared to those who were exposed to Traditional Material.

Table 9

Independent Samples t-Test on Chemical Bonding, Carbon Compounds and Mole Concept Post-test

Learning Materials	Chemical Bonding				Carbon Compounds				Mole Concept			
	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*	Mean	SD	*t*	*p*
a. Grade 9 Science	18.63	3.14	-3.182	0.001	16.31	2.97	-2.17	0.017	10.06	2.04	-3..425	0.0005
b. Traditional	16.34	2.87			14.74	3.1			8.54	1.63		

$^*N^{a,b}$= 35, $^*p$< 0.05

To see if the mean posttest scores in chemical bonding and carbon compounds were indeed significantly higher, Analysis of Covariance (ANCOVA) was done using both groups pretest mean score as a covariate with the outcome variable or posttest in order to remove variability. The results of the ANCOVA are shown in Table 10 for chemical bonding. As shown in the table 10, the main effect of treatment after removing the effects of the covariate is significant, *F* (1, 9.158) = 7.713, *p* = .007. That is, *p* (.007) < .05. The observe *F* ratio indicates that there is a significant difference on the Chemical Bonding posttest between Grade 9 Science Learner's Material and Traditional Material group. This means that the knowledge of the students who were exposed to Grade 9 Science Learner's Material was significantly enhanced.

Table 10
Analysis of Covariance (ANCOVA) onChemical Bonding Posttest

Source	Sum of Squares	df	Mean Square	*F*	Sig.
PRETEST	0.501	1	0.501	0.055	0.816
POSTTEST	**70.631**	**1**	**70.631**	**7.713**	**0.007**
Error	613.556	67	9.158		
Total	705.486	69			

$*N^{a,b}$= 35, *p < 0.05

Table 11 shows the Analysis of Covariance (ANCOVA) in carbon compounds. The effects of the covariate is not significant, *F* (1, 8.968) = 2.440, *p* = .123. That is, *p* (0.123) >.05. The observe *F* ratio indicates that there is no significant difference on the Carbon compounds posttest between Grade 9 Science Learner's Material and Traditional Material group. This means that the knowledge of the students who were exposed to Grade 9 Science Learner's Material was not significantly enhanced.

Table 11
Analysis of Covariance (ANCOVA) on Carbon compoundsPosttest

Source	Sum of Squares	df	Mean Square	*F*	Sig.
PRETEST	25.361	1	25.361	2.828	0.97
POSTTEST	**21.886**	**1**	**21.886**	**2.440**	**0.123**
Error	600.868	67	8.968		
Total	669.443	69			

$*N^{a,b}$= 35, *p < 0.05

The ten-week exposure of the students to intervention showed significant difference between the chemical bonding, carbon compounds and mole concept of Grade 9 Science Learner's Material and Traditional Material class.This showed that using the Grade 9 Science Learner's Material can enhanced the knowledge of the students compared to the Traditional Material.

One factor that increased their knowledge on the three topics in chemistry is that students are involved in hands-on activities. The activities in the Grade 9 Science Learner's Material provide an opportunity for the students to engage themselves in the actual activities in which they learn more than lecture type of discussion. Research has evidenced that hands-on approach in science improves understanding of concepts resulting in better achievement score and success in science subject area. In the study conducted by Randler and Hulde (2007) it was found out that students involved in hands-on activities scored significantly better than those taught through teacher centered experiments. Similarly, Young and Lee (2005) provided evidence that the students who were taught through science kits outperformed those students taught withoutthese.

Another factor associated to the significant difference could be the materials used in the activity were localized and improvised. Ubana (2009) stated that scientific concepts are retained better and learning tends to become more meaningful and interesting when learning materials are used. In the study conducted by Bassey (2002), reported that students taught with the standardized instructional materials had the highest achievement. Similarly, Isola (2010), conducted a research on the effects of instructional resources on students' performance also concluded that material resources have a significant effect on student's achievement. Furthermore, Iyekekpolor and Tsue (2008) carried out a study that considered the effect of improvised instructional materials achievement in mathematics. The result revealed a better mathematics on students' achievement in the experimental group.

Likewise, groupings of the students in the activity could also be another factor which helped them to improve and develop their knowledge in chemistry. Students learn better when they have opportunities for collaboration (Millis, 2005). Small group was utilized in the study in which students interact with each other. Everyone was encouraged to express their own idea during group presentation and every class discussion. Group members not only learn from their own individual efforts, but they also learn from the perspectives of the other members (Betz, 2005).

In terms of carbon compounds and achievement in chemistry the result showed no significant difference on both two groups. One possible reason is that students did not employ much of the learning strategies needed to successfully learn the topics. . According to Chinn (2006) strategy use can be influenced both by knowledge of what the strategy is and how to use it, and by belief in the effectiveness of the strategy. Learning strategies facilitate and enhance academic performance.Alexander et al. (1998) have characterized learning strategies as purposeful, in thesense that they are consciously applied to attain a desired outcome. According to Dignath and Buttner (2008), the use of adequate self-regulatory learning strategies is fundamental for students to have academic success in secondary.This is similar with the results of Cho and Ahn (2003), indicating that when students employ more strategies, they are likely to be more successful. This is consistent with the existing literature (Paris & Myers, 1981; Tait

&Entwhistle, 1996) that high-achieving students used more learning strategies than low-achieving students, both in frequency and variety.

In addition, students fail to consider the one important component of self-regulated learning which is the self-monitoring. Self-monitoring is defined as deliberately paying attention to an aspect of one's behaviour (Brenan & Schloemer, 2003; Lan, 1996). In the study conducted by Schunk (1997),results showed that the self- and external-monitoring conditions led to higher posttest self-efficacy, persistence, and achievement, than did the no-monitoring condition. This corroborated the study of Labuhn et al. (2010) who found out that learners who were taught SRL skills through monitoring and imitation were more likely to elicit higher levels of academic self-efficacy (i.e., confidence) and perform higher on measures of academic achievement compared to students who did not receive SRL instruction.

Furthermore, the retention rate of knowledge of students is low. This is because most of the concepts in chemistry are abstract. In chemistry, most concepts can be understood at the macroscopic level, submicroscopic and symbolic levels (Johnstone, 1993). These three levels were positioned at the vertices of a triangle and stress that *"every learner studying chemistry for whatsoever purpose needs to perform within thetriangle"*(Johnstone, 1993, p.703). Similarly Bowen & Bunce (1997) used the three forms of representations: macroscopic, submicroscopic (particulate), and symbolic to stress conceptual understanding in problem solving as the ability to symbolize and translate chemical problems. Also, according to Dale (1969) action-learning techniques result in up to 90% retention.People learn best when they use perceptual learning styles. Perceptual learning styles are sensory based. The more sensory channels possible in interacting with a resource, the better chance that many students can learn from it. According to Dale, instructors should design instructional activities that build upon more real-life experiences.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are suggested:

1. Teachers are encouraged to expose and train students to become self-regulated. This will help them improve their academic performance and essentially become life-long learners.
2. Seminar-Workshops and other in-service training programs which focus on the self-regulated learning (SRL) must be conducted so that teachers will be fully equipped of the knowledge and skills necessary to their fields.
3. Curriculum makers develop curriculum that would educate science-literate students who are able to be the" master of their own learning".
4. Future researchers in chemistry education and science education may investigate the effectiveness of the Grade 9 Science Learner's Material not only in Chemistry part but also the other areas of Grade 9 Science Learner's Material whether it can enhance SRL and achievement of students.
5. It is also suggested to investigate on the factors affecting SRL and achievement in Chemistry such as the sample size, duration of the conduct of the study and pedagogy of teaching whether it has effects on students' achievement and SRL or not.

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