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Strategic Intervention Material-Based Instruction, Learning Approach and Students' Performance in Chemistry

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Abstract. This study explored the learning approach adopted and attempted to investigate the effect of Strategic Intervention Material-Based Instruction (SIM-BI) on the performance of students in high school Chemistry. It utilized the pretest-posttest pre-experimental design. The SIM-BI used as a treatment of the study covered one of the least mastered skills in the subject area which is chemical bonding. Two classes of 80 students enrolled in Chemistry during the fourth quarter of the school year 2012-2013 were used as respondents. They were classified according to their learning approaches which were on their mean scores in the Chemistry Learning Approach Inventory (CLAI). The score in the Chemistry Achievement Test (CAT) administered as pretest and posttest measured students' performance in Chemistry. Dependent t-test was employed to determine the significant difference between the mean responses in the pretest and posttest. Results of the study showed that the use of SIM-BI is effective in terms of improving students' performance and learning approach. The surface learners performed equally well as the deep learners when SIM-BI was used. The positive result of the survey suggested that the SIM was appreciated and appealed to both types of learners.

Keywords: strategic intervention material; learning approach; performance in chemistry

Introduction

It is a common observation that learning Chemistry, as a discipline creates a negative feedback to most students in the secondary level. Chemistry is one of the hated subjects in Science, which students would likely fail completing the necessary requirements and get low performances in both academic and conceptual reasoning skills. To many students, Science learning is never fun and the process is boring and burdensome; thus, student achievement in this field is relatively low.

The Trends in International Mathematics and Science Study (TIMSS 2003) which was conducted nine years ago revealed unsatisfactory results. The Philippines ranked 42nd in Science out of 45 participating countries that were tested (Manila Times, 2004). TIMMS result specifically in Chemistry has an international average of 45% correct answers and Philippine average of 30 %. This proved that vast majority of Filipino students have performed below par in the Chemistry achievement test and below the levels of most students from other countries based on the international tests.

The mediocre difference in the academic performance of students is also evident in the results posted in the National Achievement Test given by the Department of Education (DepED) to elementary and high school students. In the year 2007, Chemistry posted an average of 51.8 %, 57.8 % in 2008 (Espinosa, 2012). The results are far and below the criterion target set by the Philippine government which is 75% (Lapuz, 2009) cited. This problem in the education system is now being addressed by the government through adopting the K-12 program. This program being implemented by the government extends the basic education curriculum from 10 to 12 years. DepEd reasoned that it is high time to implement this system in the basic education attributing the low achievement scores of students nationally and internationally.

In the present situation of the Philippine Educational System, wherein there are shortage in the classrooms throughout the country and scarce funds, not enough to cater instructional materials needed in every science classroom. The primary goal of teaching is to provide appropriate and effective instruction to students. Thus, a Science teacher is responsible to devise and provide the necessary materials for use in science classes (Dy, 2011). Teaching Chemistry is more productive when there are available, sufficient, and strategically designed instructional materials suited for the type of students. Instructional approaches may succeed or fail, they are dependent to the learning needs of the students. Teachers must consider the students' emotional needs and their approaches to learning. Developing instructional materials play an integral role in the teaching – learning process. Use of instructional materials has a strong relationship with academic performance at the secondary students as mentioned in Dahar(2011).

Strategic Intervention Material, an instructional material for remediation purposes is one of the solutions employed by the Department of Education to enhance academic achievements of students performing low in the field of science and technology. DepEd Memo No. 117, series of 2005 entitled "Training

Workshop on Strategic Intervention Materials (SIMs) for Successful Learning" provided science secondary teachers the training in the preparation of SIMs. As part of intensifying and developing strategic intervention materials as tool for remediating poor performance in Science. The Department of Education included the SIM making as one of the contests during science fairs in school, division, regional, and national level competitions.

One of the most significant topics today in the field of educational research specifically in the basic education is the learning approach adopted by the students in learning a particular task. For educators, this approach should be considered and applied most of the time in teaching (Lublin, 2010). One of the major concepts that emerged from this research was the idea that students can take different approaches to learning. Biggs (2003) defines good teaching as the encouragement of a deep approach to learning.

In the light of this the paper was conceived. This study investigated the effect of traditional teaching with the use of a strategic intervention material made by the researcher to help improve students' performance considering the learning approach they adopt in Chemistry. It is hoped that students' learning approach, from being a surface learner to deep learner upon exposure to Strategic Intervention Material – Based Instruction will be realized.

The study sought answers to the following research questions: (1) What is the profile of the students in chemistry before and after exposure to Strategic Intervention Material – Based Instruction (SIM-BI)?; (2) What is the performance in the Chemistry Achievement Test (CAT) of deep and surface learners before and after exposure to the Strategic Intervention Material – Based Instruction (SIM-BI)?; (3) Is there a difference between the performance in the Chemistry Achievement Test (CAT) of deep and surface learners before and after exposure to Strategic Intervention Material – Based Instruction (SIM-BI)?; (4) What is the students' perception of the Strategic Intervention Material – Based Instruction (SIM – BI)?;

Strategic Intervention Material (SIM)

Instructional materials are school resource inputs (SRI), they include print and non – print items that are designed to impart information to students in the educational process. Instructional materials also include items such as kits, textbooks, magazines, newspapers, pictures, recordings, slides, transparencies, videos, video discs, workbooks and electronic media including music, movie, radio, software, CD – ROMs, and online services (Dahar, 2011). Instructional material plays a very important role in the teaching learning process. It enhances the memory level of the students and makes the teaching – learning process interesting (Nicholls, 2000; Raw, 2003).

At present, in the Philippine education system, intervention materials are highly regarded as tools for remediating poor achievements of the learners. SIM or Strategic Intervention Material refers to a teaching aid introduced into the teaching methods to stimulate the activity of the students and thereby increased

their level of understanding (Dy, 2011). It is strategically prepared and designed for teaching remediation for low achievers in the subject. It is given after the regular classroom instruction to students who were not able to grasp the concepts of the subject matter.

Bunagan (2012) defined Strategic Intervention Material as meant to re-teach the concepts and skills (least mastered). It is a material given to students to help them master competency – based skills which they were not able to develop during a regular classroom teaching. It consists of both learning strategies (for students) and content enhancement (for teachers). It is a multifaceted approach to help students to become independent and successful learners. He further differentiated SIM and modules. This intervention material focuses on the skill not mastered by the students during regular class. It does not involve pretest and posttest and includes fun activities. Module, on the other hand, contained different topics included in a given chapter and intended for regular classroom teaching and distance learning. Module requires pretest and posttest and also includes fun activities.

SIM increases and deepens students' skills in manipulation, knowledge or thinking, understanding and observing the microscopic into macroscopic representation of matter like atoms, molecules and ions which students believe as a discrete representation of the existing matter and other related components of science (Togonon, 2011).Strategic Intervention Material is an instructional material prescribed by the Department of Education to improve students' performance in science subjects. To promote successful learning in the field of science and technology subjects in both elementary and secondary among public schools, DepEd Memorandum No. 117, series of 2005, provided the teachers the training and workshop on how to prepare this intervention material. As part of promoting the wide use of the material, the Department of Education included SIM making that is open to all science teachers as one of the contests in yearly science fair in the school, division, region and national level competitions.

The Strategic Intervention Material (SIM) is divided into six parts taken from the seminars and trainings attended by the researcher. The first part of the SIM is the title card, this part of the SIM includes the specific chapter or the subject matter covered by the material. The SIM that was used in this study is entitled "Chemical Romance" that covers chemical bonding which is considered least mastered skills in Chemistry.The second part is the guide card. This section gives a preview of what students will learn. This card should stimulate the interest of the students with respect to the topic covered by the strategic intervention material. It presents the focus skills mentioned in the learning competencies and must state at least two sub-tasks (activities). This part must also cite prerequisite skills built on prior learning and concrete outcome or product that students are expected to demonstrate or produce.

The third part of the SIM is the activity card. This section is considered the heart of the Strategic Intervention Material. It consists of activities that will develop understanding of the students related to the given objective of a specific lesson

stated in the guide card. It contains also guide questions for the students to answer and relate the activity conceptually, that will be developed after completing the main activity. This part also provides the objectives, students' exercises, activities, and drills with clear directions to develop necessary skills in the three domains and concrete concepts, particularly those drawn from real – life situations. It allows also the students to organize based on the sequence of the focus skills and to make discoveries and formulate ideas on their own. This section also consists of questions that establish relationship between the topic and what students already know or familiar to them.

The fourth part is the assessment card that is made up of activities and tests concerning what the students learned from the previous activities of the SIM. This test measures how much students learned from the given activities in the activity card. It is made up of questions in different forms (multiple choice, interpreting graph, identification, and matching type). This section determines the effect of this material as a tool for teaching remediation.

The fifth part of the SIM is the enrichment card. This section provides practical activities to be done by students related to the topic. This involves applications of the topic in their daily life, in industry or in other technologies. The last part of the SIM is the reference card which includes the title of the books, websites, or any other electronic or printed materials. This part may be used by students as reference for additional information concerning the topic covered.

Traditional Instruction Supported with Instructional Materials

Nowadays, traditional and modern teaching methods become a hot topic in education. Traditional teaching activities refer to the learning process activities. The examples of traditional teaching activities methods are using games and singing a song in and out the classroom (Heriwinarko, 2012). A very typical feature of traditional methodology as Broughton (2004) claimed, is the "teacher – dominated interaction". The teaching is deeply teacher – centered. The traditional methodology puts the responsibility for teaching and learning mainly on the teacher and it is believed that tudents will be able to use the knowledge if they are present in the class discussions and listen to the teacher's explanations and examples, (Boumova, 2008).

The Center for Integration of Research, Teaching and Learning (CIRTL) cited the advantage and disadvantage of traditional teaching method: such as, giving the instructor the chance to expose students to unpublished or not readily available instructional materials and complimenting certain individual learning preferences. Some students depend upon the structure provided by highly teacher – centered methods. Two of the disadvantages mentioned are to enable understanding and long-term retention of content, it requires considerable amount of unguided student time outside the classroom and it does not promote active learning but rather placing students in a passive role which hinders learning.

Today's diverse student population has resulted in teacher's seeking changes in the traditional methods of instructing students. Teachers seek ways to improve

student motivation and engagement in the learning process. Students learn principally through interactions with people (teachers and peers) and instructional materials (textbooks, workbooks, instructional software, web-based content, homework, projects, quizzes, and tests). But education policymakers focus primarily on factors removed from those interactions, such as academic standards, teacher evaluation systems, and school accountability policies. There is strong evidence that the choice of instructional materials has large effects on student learning—effects that rival in size those that are associated with differences in teacher effectiveness. Administrators are prevented from making better choices of instructional materials by the lack of evidence on the effectiveness of the materials currently in use (Chingos, 2012)

In order to facilitate the learning process, instructional media are used as aids. Instructional media are classified as speaking – listening media, reading – writing media and computer – based instruction (Aranes, 1998). For purposes of the study, the researcher will center his discussions to visual and observational media which specifically concentrates on the application of intervention material in teaching one of the least mastered skills in Chemistry.

Non-book instructional materials have opened up a new research field particularly in the past 30 years. Similarly, in the most recent comprehensive summary in the audio-visual field, numerous books and periodicals have made an effort to bring together more recent findings. This investigation concerning the use and purposes of instructional materials in teaching showed that there are many studies merely attempting to demonstrate the superiority of one type of learning material over another (Broderick, 2012). This research tried to investigate one type of instructional material without comparing to others.

Students' Performance in Chemistry

Chemistry is one of the most important branches of Science, it enables learners to understand what happens around them. Chemistry topics are generally related to or based on the structure of matter. In fact, Chemistry is often regarded as a difficult subject, an observation which sometimes repels learners from continuing studies of the subject (Sirhan, 2007).This statement is supported by documents of test results obtained from third year students of Makati High School for the school year 2010 – 2011.

Based on the result of the first quarter Division Achievement Test (DAT) in different subject areas, Chemistry ranked fourth which has a mean percentile score (MPS) of 42.96 %; Filipino, 53.15 %; AralingPanlipunan, 52.76 %; English, 48.25%; and Mathematics, 41.34 %. From the results, it can be inferred that students in Chemistry performed far below mastery.

In the second quarter DAT result, English has an MPS of 59.05%; AralingPanlipunan, 55.67%; Filipino, 52.62%; Mathematics, 48.16%, and Chemistry ranked 5th with an MPS of 43.55%. The third quarter DAT result is quite higher compared to the previous quarters. AralingPanlipunan has an MPS of 84.85%; English, 79.75%; Mathematics, 68.32%; Filipino, 65.34%; and

Chemistry 64.45%, again ranked last among the five subjects. For the fourth and last quarter of the Division Achievement Test for the school year 2010 – 2011, test results showed that Chemistry ranked 5th with an MPS of 40.16 % next to Filipino with 68.21%, English with 54.45%, Mathematics with 42.37%, and AralingPanlipunan, 41.67%.

To sum up the Chemistry Achievement, the highest mean percentile score was registered during the third quarter of the school year where the topics covered are gas laws, atoms and periodic trends. Second in the rank is the second quarter covering solutions, colloids and chemical change with a mean percentile score of 43.55%.Third in the DAT result is the first quarter with an MPS result of 42.96% with topics covered on classifying matter, and techniques of separating mixtures, and ranked last registered during the fourth quarter with an MPS of 40.16% covering chemical bonding and chemical reactions. These results suggest that topics in the fourth quarter such as chemical bonding and chemical reactions are the most difficult and least mastered in the subject area. Thus in this study, a strategic intervention material was developed on the topic of chemical bonding to improve students' poor performance.

Students' Learning Approach

A learner can be classified based on the learning approach he/she adopts for every task given. Student Approaches to learning is a theory that describes what students do when they go about learning and why they do it. Students will take different approaches on how they study depending on the perceived objectives of the course they are studying. The original work on learning approach was carried out by Marton and Saljo as mentioned in Miguel (2012). The two original proponents proposed that students' learning approach could be divided into two distinct groups, those who took an understanding approach to learning and those who took a reproduction approach to learning. The first group that tried to understand and comprehend the totality of the lesson was identified as deep learners. Whereas, the second group that tried to remember facts contained within the text and demonstrated an approach that would recognize as rote learning or a superficial surface approach was classified as surface learners.

According to Morton, as cited in Miguel (2012), a learning approach is not what a student has. It describes a relation between a student and the kind of learning he or she adopts. Based on their intentions to learn, a student can be classified as deep or surface learner (Entwistle, 2004). Intent just to fulfill the task's requirements like memorizing to pass an examination, a student is considered a surface learner. A surface learner arises when the student sees learning as a means to achieve an end. Students who adopt this approach are motivated by an extrinsic objective and they will commit unrelated facts to their short time memory but are unlikely to be able to establish meaning or relationships between or within given tasks.

Ramsden (1985), as mentioned in Daluz (2003) notes that while a surface approach will inevitably lead to poor understanding, a deep or achieving approach to a high level of understanding should not be extended to the view

that a surface approach is necessarily adopted by weaker students and deeper approach by highly competent ones. The approaches to learning are not necessarily exclusive. Students may adopt different approaches according to the task, the course or the teaching context. Learning approaches are not stable traits in individuals, although some students will tend towards taking a deep approach while others will tend towards taking a surface approach (Biggs, 1999). Rather, it is suggested that good teaching can influence students to take a deep approach. In this sense, teachers have a direct and powerful impact on the learning outcomes of the students.

Students adopting surface approaches to learning are terms that most educators and academicians have heard and got interested in. Learners may be classified as "deep" and "surface" learners, they are not attributes of individuals. One person may use both approaches at different times. This idea of learning approach is probably one of the most interesting topics for educational research for both basic and higher education. It is a very powerful and useful theory that educators should consider and apply most of the time in teaching.

Table 1 compiled from the work of Biggs (1999), Entwistle (1988), and Ramsden (1992) as cited in Miguel (2012) provides valuable characteristics of the deep and surface learners.

Table 1.
Characteristics of Deep and Surface Learners

Criteria	Surface Learner	Deep Learner
Definition	Accepting new facts and ideas uncritically and attempting to store them as isolated, unconnected items.	Examining new facts and ideas critically, and tying them into existing cog - nitive structures and making numerous links between ideas.
Characteristics	(a) Relying on rote learning (b) Focusing on outward signs and the formulae needed to solve a problem. (c) Receiving information passively. Failing to distinguish principles from examples. (d) Treating parts of modules and programs as separates. (e) Not recognizing new material as building on previous work. (f) Seeing course content simply as learnt for the exam	(a) Looking for meaning (b) Focusing on central argu- ment or concepts needed to solve problem. (c) Interacting lively (d) Distinguishing between argument and evidence. (e) Making connections bet- ween different modules. (f) Relating new and previous knowledge.
Encouraged by Teachers	(a) Conveying disinterest or even negative attitude to the material. (b) Presenting material so that it can be perceived as a series of un- related facts and ideas. (c) Allowing students to be passive. (d) Assessing for independent facts (short answer question). (e) Rushing to cover too much material. (f) Emphasizing coverage at the expense of depth. (g) Creating undue anxiety or low expectations of success by discouraging statements or exces- sive workload. (h) Having a short assessment cycle.	(a) Showing personal interest in the subject. (b) Bringing out the structure of the subject. (c) Concentrating on and ensuring plenty of time for the key concepts. (d) Confronting students' misconceptions. Enga- ging students in active learning. (e) Using assessments that require thought and ideas to be used together. (f) Relating new material to what students already know and understand. (g) Allowing students to make mistakes without penalty and rewarding effort. (h) Being consistent and fair assessing declared intended learning out- comes, and hence estab- lishing trust.

The researcher conducted a review of articles from foreign and local studies relevant to the present study. This is presented in the paragraphs that follow.

Aguele (2010) studied the effectiveness of selected teaching strategies on the remediation of process errors committed by students in Mathematics. The study employed the quasi – experimental design. Sample for the study consisted of 207 students drawn from six senior secondary schools in Edo State. The diagnostic test on Mathematics (DIATOM) was used to collect data for the study. Data collected were analyzed using analysis of covariance (ANCOVA) and z-test for

two population proportions. Results of data analysis revealed that the direct instruction (DI) was a more effective strategy for the remediation of process errors committed by students in Mathematics. The study further recommended that enough practice activities should be given to students during class sessions to assist them develop mastery of content taught. Remediation should be seen as an ongoing process during normal classroom instruction. These results agree with the study of Din (2000) that direct instruction (DI) once used effectively could help students to remedy their basic mathematical skills.

Further, Dahar (2011) investigated the effect of availability of instructional materials on the academic performance of students in Punjab (Pakistan). He mentioned that instructional materials play a very important role in the teaching - learning process. Population of the study comprised all secondary and higher secondary schools, secondary teachers and secondary students in Punjab. A total of 288 schools, 20 students and 10 teachers from each school were randomly selected as the sample of the study. The study used the value – added approach. School Profile Proforma, a questionnaire for teachers and result sheet were the instruments of the study. Pearson correlation was used to find out the relationship between the availability of instructional material and academic performance of students and Stepwise Regression analysis with linear function was used to find out the differential impact (causal – relationship). Results revealed that availability of instructional materials has a strong relationship with academic performance of the students.

Moreover, Anderson (2012), cited in his study on the Study – Teaching of Quantitative Genetics that intervention material consisted of a series of computer-based materials and concept mapping exercises helped in improving and addressing identified difficulties and alternative conceptions on Genetics given to third year introductory module in quantitative genetics. He also found out in this study that the knowledge of the student group that participated in the intervention (experimental group), indicated a highly significant difference compared to the control group in terms of improving the understanding of the concepts of variance, heredity, and histogram in Genetics.

Similarly, the study conducted by Escoreal (2012) on the Strategic Intervention Material tool to reduce least mastered skills in Grade 4 science, concluded that SIM provides baseline information and should be implemented to avoid marginalization of pupils. Her study also indicated that there is a significant reduction ($p < 0.05$) in the pupil's mean number of least mastered skills after SIM implementation.Furthermore, Soberano (2010) mentioned that strategic intervention materials were effective in mastering the competency based –skills in chemistry based on the mean gain scores in the posttests of the experimental and control groups. He found out that there was a positive transfer of learning in both groups. However, higher mean was observed from the experimental group after the presentation of the intervention materials. The posttest result of the control group was likewise significant. The difference of 26.2727 between the posttest and pretest of the control group was significant at 0.05 level. The computed t-value between the posttests of the experimental and control groups

was 8.289 at tabular value 1.67, degrees of freedom 64 and 0.05 significance level. This suggested that there was significant difference between their mean scores in the posttests in favor of the experimental group.

Similarly, according to the study of Togonon (2011), on the development and evaluation of project – based strategic intervention materials (PB-SIMs), PB-SIM is a valid instructional material in teaching high school chemistry. Results showed a significant difference between the achievement of the students before and after being exposed to PB – SIMs. The pretest yielded a mean of 4.2167 and the posttest mean of 10.6500. The p value associated with the computed t – value is less than the adopted level of significance. The students exposed to SIM performed better in the posttest than the pretest. The results of the study were in line with the findings of Hogan (2000) and Woodward (2004) as cited in Soberano (2010) who found out that intervention materials contributed to better learning of the concepts among students. The PB-SIMs significantly improved the achievement of students in Chemistry specifically in solutions and colloids. She also mentioned that PB-SIMs improved the perceptions of students toward the subject.Dermirci (2001) conducted a study on the effects of web-based Physics software program on students' achievement and misconceptions. The study supported the web-based Physics software program with traditional method. The result showed a significant effect on dispelling students' physics misconceptions in force and motion concepts.

Morgil (2003) made a study on the traditional and computer assisted learning in teaching acids and bases in Chemistry. The traditional and the computer assisted teaching methods for teaching a fundamental topic in chemistry education acids and bases were compared. The students were randomly distributed into control and experimental groups and their knowledge on the topic were pretested. After the test, the experimental group received computer assisted teaching and the controlled group was taught by traditional teaching methods for two days. The result incurred 52% improvement in the post instruction test results of the experimental group; whereas, the controlled group only improved 31%. The independent two-sample t-test revealed that this difference in the achievement was significant favoring the experimental group.

Imdieke (2000) investigated the effect of two different teaching methods, the traditional science instruction with hands -on activities and traditional textbook science instruction with worksheets to determine which method of science instruction is more beneficial to elementary science students. Based on the results, student in the hands -on group achieved higher scores than those in the worksheet groups. Conclusions drawn from the data show a significant difference in the achievement of hands- on group with a means score of 94% in contrast to the worksheet group means score of 82% using the 0.05 level of statistical significance. Another important difference between the two groups was their SD scores. The hands-on group's SD was 5.44 in contrast to the worksheet group which scored 15.3. This difference shows that majority of the students who learned by using hands-on activities achieved at the higher level when compared to those who learned by using the worksheets.

Similarly, Jiris (2009) mentioned in his study on the integration of animated movies into Science education that the use of animated movies enhanced students' science understanding, knowledge and reasoning ability. The research was based on the quantitative methodology using the pretestposttest experimental design. The teaching method –integration of animations was the independent variable, while the dependent variables were: students' understanding, reasoning skills and motivation to learn science. The experimental students (N = 1292) integrated science with web-based animations as part of the science curriculum. The controlled students (N = 725) continued studying science courses in traditional way – using books and worksheets. The animated movies were presented to the students at least once a week, about one animation for each topic taught in class. The study also indicated that students who studied science with the use of animated movies developed higher motivation to learn science compared to students in the control group.

Whereas, Rondon (2013) made a study on the effect of a game – based and traditional learning method on the students' knowledge retention. His study revealed that students who received game-based method performed better in both posttest in anatomy and physiology questions. He further stated that game-based learning method is comparable to the traditional learning method in general and in short - term gains, while traditional lecture still seems to be more effective to improve students' short and long term knowledge retention.

Miguel (2012) made a study on the achievement and retention of learning of deep and surface learners exposed to UbD. The study was conducted at Ramon Magsaysay High School during the first quarter of S.Y. 2011 – 2012. The sample of the study was categorized as deep or surface learners. T-test was employed to assess the difference between the performance of deep and surface learners. Results showed that the use of the UbD is effective in terms of enhancing students' achievement while retention of learning is comparable regardless of learning approach.

Hamm (2009) investigated the performance of deep and surface learners using the Digital Audio Video Assessment (DAVA) and found out that multimedia teaching and learning approaches encourage learners to adopt a richer, creative and deeper level of understanding and participation within the learning environment than traditional teaching and learning methods. Research shows that DAVA promotes deep learning and understanding. Some factors mentioned in this study that are critical in affecting the overall learner experience were the learner's well developed learning preferences, issues relating to technology incidents and problems and the teacher's own level of skills, training and knowledge of the assessment. He further asserted in his research that learners exhibited flexible learning preferences adopted either a deep or surface approach related to their motive or strategy. Based on the evidence, some of the participants who were classified as surface by Biggs, midway between deep and surface, changed to deep when doing the DAVA. He argued that the reasons for the deep approach transformation by these learners were: students have

enjoyable and rewarding experiences and the DAVA suit to their learning experiences.

Estacio (2008) attempted to study the effect on the achievement in Physics of students taught with enforced diagramming. The study was conducted at the Technological University of the Philippines – Manila campus. The study was focused on the conception of force and motion. This study found out that enforced diagramming method can be used to enhance achievements of surface learners.Whereas, Beran (2005) compared the performance of deep and surface learners in problem solving. In her study, she mentioned that deep learners are better than surface learners. Deep learners favored algorithmic strategy wherein the solutions use the correct formula and involved correct substitution of the given data. However, surface learners favored the systematic trial and error strategy that shows some irrelevant formulas and error in solving the problem.

In the study comparing the effectiveness of the students teams achievement division (STAD) and chalk and talk lecture method (CTLM) on the achievement of deep and surface learners by Biton (2001), results revealed that students exposed to STAD achieved better than those exposed to CTLM. She also stated that STAD worked well for both students with different learning approaches.

Similarly, Aranes (1998) made a study on the achievement of deep and surface learners using illustrated laboratory procedure in Chemistry. The study was conducted at the Technological University of the Philippines using four intact classes of 93 sample students enrolled in General and Inorganic Chemistry during the second semester of the school year 1997 – 1998. The total sample population was divided into two groups, 46 belonged to the experimental group while 47 students classified for the control group. The findings of this study revealed that students in the experimental group significantly performed better than those in the control group. Using illustrated laboratory procedures in chemistry, surface learners could afford to perform equally well as deep learners, and a significant interaction effect exists between the teaching method and learning styles of the students. The surface learners favor the use of regular laboratory manual, whereas the deep learners favor the illustrated laboratory procedure.

Further, Tonel (1997), showed in her study on the effectiveness of teacher resource material in Physics in teaching deep and surface learners that students who adopt the deep approach tend to perform better than students who adopt the surface approach. The resource material was found effective in enhancing student learning.

Synthesis

Based on the presented information from different sources, such as books, unpublished theses and the Internet, one way to improve student performance specifically in the least mastered skills of the subject area, is the utilization of an instructional material. Studies revealed that the use of an instructional material plays a very significant role in enhancing the memory level of the students and makes the teaching – learning process interesting.The use of Strategic

Intervention Material (SIM) as prescribed by the Department of Education is one of the treatments to improve students' achievement and reduce least mastered skills in science subjects. Different studies have shown that the use of SIM successfully decreased the least mastered skills in science subjects; thus, poor achievement was enhanced.

Five related studies (Dermirci, Morgil, Imdieke, Jiris, and Rondon) considered the traditional method of instruction. Based on these studies, traditional teaching method alone does not promote high academic achievement in science. However, when this method was assisted with technologies and available instructional materials it improved students' performance. The present study utilized Strategic Intervention Material – Based Instruction (SIM – BI) while the above related studies used traditional teaching instruction assisted with computer programs and other technologies.

Results of various studies encouraged the researcher to study the effect of Strategic Intervention Material – Based Instruction (SIM – BI) as a tool in improving students' performance in Chemistry and its effect on the learning approaches of students. Soberano, Togonon, Escoreal, Dahar, Aguele and Tonel tested the effectiveness of instructional and intervention materials. It is worth noting that these studies were successfully established its positive effect on learning.

Studies on the learning approaches with instructional materials (Miguel, Hamm, Estacio, Beran, Biton, Aranes, and Tonel) were also considered in this research. These studies used different teaching instruction to determine the effect on the performance of students with different learning approaches. The present study employed Strategic Intervention Material – Based Instruction (SIM – BI) to investigate the effect on the learning approaches and performance of students in Chemistry.

In this study, the developed Strategic Intervention Material in Chemistry was used as intervention material during the instruction on the topic chemical bonding to improve students' performance and determine its effect on their learning approach.The studies reviewed may not be that extensive on the factors of changing the learning approaches considering the wide - range of literature that exist in this particular topic. Nonetheless, the study mentioned already the baseline information on the conceptualization and conduct the present study which led to a hypothesis, that the Strategic Intervention Material – Based Instruction (SIM – BI) has significant effects on students' learning approaches and performance.

Research Paradigm

The paradigm illustrates the possible effect of SIM - BI on deep and surface learners' performance in Chemistry.

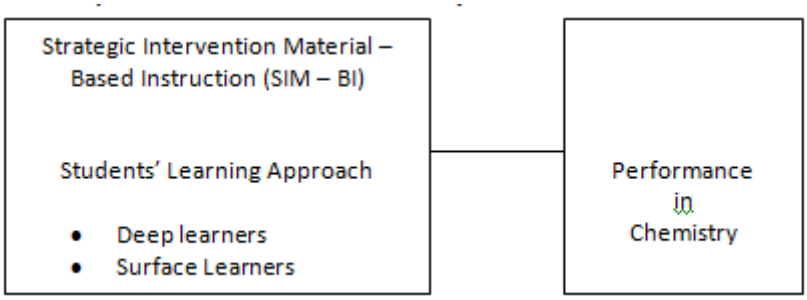

Figure 1. Research paradigm of the study

The research paradigm shows the relationship between SIM - BI and students' learning approach and their performance in Chemistry. In the study, the Strategic Intervention Material – Based Instruction (SIM - BI) in chemical bonding and learning approach were the independent variables and the performance of deep and surface learners in Chemistry was the dependent variable.

Research Hypotheses

The research hypotheses below were tested at the 0.05 level of significance express in alternative form.

1. There is a significant difference between the achievement test means of deep and surface learners before the exposure to SIM - BI
2. There is a significant difference between the achievement means of deep and surface learners after exposure to SIM – BI.
3. There is a significant difference between the achievement test mean scores of deep learners before and after exposure to SIM – BI.
4. There is a significant difference between the achievement test mean scores of surface learners before and after exposure to SIM – BI.

Research Design

The study is descriptive – experimental and used the pretest – posttest pre-experimental design. Descriptive part of the study involves the learning profile and the students' perception survey. Experimental part of the study is the students' performance in Chemistry. Qualitative analysis was employed for the learning approach of students before and after exposure to SIM-BI, students' perception on the use of the strategic intervention material, and students' performance in the Chemistry Achievement Test. Quantitative analysis was used to determine any difference between the pretest and posttest means. The pretest – posttest experimental designed for this study is presented below.

O1 X O2

Where: O1 – pretest
X – Treatment (SIM – BI)
O2 - Posttest

The Sample

Two sections from the third year level of Makati High School for the school year 2012-2013 (III – Pearl and III –Zircon) were used as respondents of the study. The sample consists of 80 students with 36 males and 44 females selected from 18 sections through convenience sampling. These sections are heterogeneous and handled by the researcher. The researcher had a total contact time with each section equivalent to six hours in a week. The daily schedule for the Chemistry class for the III – Pearl and III – Zircon is from 6:40 A.M. - 7:40 A.M. and 10:00 A.M. – 11:00 A.M., respectively. An additional 1 hour for each section was allotted for the completion or remedial class to III – Pearl every Tuesday and Wednesday for III – Zircon from 1:20 P.M. – 2:20 P.M.

Research Instruments

In the conduct of the study, the researcher used five research instruments, the Chemistry Learning Approach Inventory (CLAI), Strategic Intervention Material (SIM), Chemistry Achievement Test (CAT), Students' Perception Survey (SPS) and Observer's Evaluation Questionnaire (OEQ). The CLAI was adopted from Beran (2005) and the rest was developed by the researcher and validated by experts.

Chemistry Learning Approach Inventory (CLAI)

The Chemistry Learning Approach Inventory (Appendix B) was used to classify students as deep and surface learners. It is a questionnaire that classifies students on what learning approach they adopt in learning the concepts of the subject matter.

This questionnaire consists of 30 questions with English and Tagalog version. Half of the questions (1,3,4,5,7,9,11,13,15,17,19,21,23,27,29) were positively stated; whereas, the other half (2,6,8,10,12,14,16,18,20,22,24,25,26,28,30) were negatively stated. Students chose the statement that applied to them using scales from 1 – 4 with their corresponding qualitative descriptions in English and Tagalog version. A rating of 1 in every item is equivalent to Never (Hindi), 2 is Seldom (Madalang), 3, Often (Madalas) and 4 is Always (Palagi).

The ratings given to negative items were subtracted from five (5) prior to getting the total scores. The students were classified based on their mean scores obtained in the CLAI. The mean score of the student was computed by dividing the total scores by 30, the total number of items. In this study, the mean score of the student was the basis for classifying him/her as to what type of learner he/she belongs. Students with a mean score of ≥ 2.5 were classified as deep learners and those with mean score of < 2.5 were classified as surface learners.

Strategic Intervention Material (SIM) in Chemical Bonding

The SIM that was used in this study is entitled "Chemical Romance" that covers chemical bonding which is considered least mastered skills in Chemistry. It involves chemical combination of different elements leading to the formation of another compound. The SIM tackles why and how the atoms combine, the different types of chemical bonding, its nature and properties. It also includes how to use the electronegativities of elements in predicting the type of chemical bond that exists.

The SIM was divided into two lessons. Lesson 1 discusses the introduction of chemical bonding which consists of six activity cards and two assessment cards. On the other hand, lesson 2 covers the different types of chemical bonding with seven activity cards and two assessment cards. The first lesson in SIM started with the guide card presenting the overview of the whole lesson. Under this part, the objectives of the lesson were stated and students' corner was provided for the understanding check of the respondent. Guide card 1 consists of two activity cards about predicting stability and the energy involved in chemical bonding. Guide card 2 discusses the Lewis Electron Dot Structure (LEDS) as a tool of illustrating how bonds between elements are formed. It contains one activity with guide questions. Each activity card of the SIM consists of the "For Your Information" (FYI) section. This provides the basic information on the specific topic tackled.

Guide Card 3 deals with ionic formation with three activity cards involving isoelectronic, protons and electrons, charge of the atoms, oxidation numbers, types of ion, valence electron, group number of elements in the periodic table, process to become stable and the ionic symbol. Diagrams were presented in the lesson for better understanding of the students. Lesson 1 ended with two assessment cards. The first assessment card was a modified true or false and identification type for the second assessment. It measured the learning gained by the students in the first lesson.

The second lesson discusses the types of chemical bond, namely ionic bond, covalent bond, and metallic bond. It also covers the polarity of a molecule and its characteristics. Guide card 1 in this particular lesson deals with comparison of the three types of bond in terms of the classes of elements present. There are three activities provided in the lesson. The first two activity cards are all about classifying elements using the periodic table. The third activity is the application of the first two activity cards in determining the types of bond present in a compound based on the classes of elements.

Guide Card 2 concentrates on the first type which is the ionic bond. In this lesson, it uses the Lewis Electron Dot Structure as previously learned by the respondents in lesson 1, in illustrating how bonds are formed between two different types of elements. It integrates the ratio of the elements when combined, the chemical formula and name. Guide Card 3 discusses covalent bond in terms of sharing the electrons to attain stability of elements involved and the Lewis structure of a molecule.

Guide Card 4 covers the types of a covalent bond, namely, polar covalent and non polar covalent bond. It consists of three activity cards. The first and second activity deal with the use of electronegativity difference in terms of predicting the bond type. The last activity involves the correct LEDS of a covalent molecule. Two assessment cards were provided to measure the amount of learning transferred and retained to the respondents. The first assessment card is a concept map type of test and a multiple choice questions for the second.

The last two parts of the SIM were the enrichment and reference cards. Under enrichment card, students were asked to conduct an interview to owners or employees regarding their knowledge of the science behind hair rebonding. Reference card which contains title of books and internet websites was also provided as additional reference related to the topic covered by the SIM.The SIM underwent phases of validation. The material was prepared by the researcher and validated by three experts in Chemistry. Suggested ideas by the experts were incorporated in the content of the SIM. These include diagrams, improvement of guide questions and additional activities under the activity card.

Chemistry Achievement Test

The researcher made and developed a 30 multiple – choice item chemistry achievement test in chemical bonding and was used as instrument in the study. The achievement test measured the cognitive skills of the respondents: namely, content, application and procedure. The test was developed following a table of specifications (Appendix D2). The total score in the Chemistry Achievement Test is 30.

The first draft was a 50 item questions (Appendix D) presented to the thesis mentor and two experts in chemistry for content validation. Comments and suggestions mostly on the test construction such as clarity of the stem and attractiveness of the options by the experts were incorporated in the test. The second draft was given to fourth year students who already took chemistry. Result of the test was subjected to item analysis (Appendix D1). Based on the result out of 50, 29 items were considered good questions, 4 items needed revision and 17 items were rejected. Rejected items were discarded in the final form of the test. Only 28 questions considered as good items from the item analysis were included in the final form of the achievement test to maintain the proportion of questions stated in the table of specifications. Two questions classified as fair in the analysis were retained in the second draft to maintain the questions about polarity of a molecule in the competency.

The second draft of the test was again given to another section of fourth year students for the reliability estimate before it was administered as pretest and posttest to the respondents of the study. Results (Appendix D3) showed that the achievement test is reliable with a reliability coefficient of 0.63 using Kuder Richardson Formula 20.

Perception Survey Questionnaire

The Perception Survey questionnaire (PSQ) (Appendix E) was developed by the researcher to determine the perceptions of the respondents regarding the use of the strategic intervention material. This survey consists of 10 questions validated by the thesis mentor and expert panels. The PSQ in the form of checklist was given to students after using the SIM. Each question was rated using 1 – 4 scales with their corresponding qualitative descriptions. A rating of 1 is equivalent to strongly disagree, 2, disagree, 3, agree 4 means strongly agree.

Observer's Evaluation Questionnaire
An observer's evaluation questionnaire (OEQ) (Appendix F) developed by the researcher and validated by experts was used to observe the teacher and the respondents during the progress of the study. The instrument consists of five questions with 1-5 rating scales in the form of checklist. A rating of 5 means strongly agree, 4 – agree, 3 – undecided, 2 – disagree and 1 means strongly disagree. Five teachers including the department head were invited to observe during the first week of the study.

Data Gathering Procedure
The first phase of the study was the administration of the Chemistry Learning Approach Inventory (CLAI) to the respondents. This questionnaire was used to determine the learning approach used by students in learning Chemistry.

The second phase was the administration of the pretest to students in chemical bonding. The test given covers the topic on chemical bonding with a total of 30 questions that was validated by experts. The test lasted for 1 hour. The result of the test was recorded for comparison purposes.
The third phase was the actual teaching using the regular instruction (traditional teaching method) of the researcher in chemical bonding. The lesson started with a video song presentation about chemical bonding. This material was downloaded from the Internet that served as motivation for the students in learning the topic. The lesson lasted for two weeks or equivalent to 12 hours contact time with the students.

The fourth phase was the study proper. Under this phase, Strategic Intervention Material (SIM) in chemical bonding was given as an intervention material after the regular instruction. Each student was given a copy of the SIM and answered activities provided involving concepts of the lesson discussed in the regular instruction. This was conducted daily within two consecutive weeks or equivalent to 12 hours under the supervision of the researcher.

The implementation of the SIM was divided according to the lessons incorporated in the guide cards, activity cards and assessment cards. In the first week of the study, activities in lesson 1 were answered based on the schedule provided. Checking of answers to the activity cards and discussion were done right after the allotted time assigned for the given session. The second lesson of the SIM which deals with the types of chemical bonding was administered in the second week with the same amount of time given in the first lesson of the SIM.

To ensure that the schedule was strictly followed, the science department head and chemistry teachers observed and described what took place in the classroom using the observer's evaluation questionnaire.

After the SIM - BI was the administration of the posttest to the respondents. On the following day the Chemistry Learning Approach Inventory (CLAI) was again given to the respondents to determine any changes in their learning approach after using the strategic intervention material (SIM) in chemical bonding.

For the final phase, the researcher administered the perception survey to gather feedbacks from the respondents. This perception survey gave the students the chance to express their reaction with regard to the use of the SIM. The schedule of activities as they have been conducted in the study is presented in Table 2.

Table 2
Summary of the Phases of the Study

Phase	Duration	Activities/Topic	Instruments	Output
1	1 hour	Determination of learning approaches of respondents	CLAI	Mean scores in CLAI
2	1 hour	Pretest	CAT	Pretest scores
3	12 hours	Regular instruction (Traditional)		
4		SIM Administration	SIM OEQ	SIM activity scores, OEQ results
	6 hours	Lesson 1 (1) GC1, AC1 and AC2 (Predicting Stability (Energy in Chemical Bonding (2) GC2 and AC3 (Lewis Electron Dot Structure) (3) GC3 and AC4 (Ionic Formation & Isoelectronic) (4) AC 5 and 6 (Type of ions and Oxidation numbers) (5) ASC 1 and 2		
	6 hours	Lesson 2 (1) GC1 AC 1A, 1B, AC2 (Types of Bond, Classifying Elements, Predicting Bond Type) (2) GC2 and AC3 (Ionic Bond, Lewis Diagram) (3) GC3 and AC4 (Covalent Bond, Lewis Structure) (4) GC4, AC 5,6, and 7 (Types of Covalent Bond) (Predicting Bond Type) (Electronegativity) (5) ASC 1 and 2		
5	1 hour	Posttest	CAT	Posttest scores
6	1 hour	Determination of learning approaches of respondents	CLAI	Mean scores in CLAI
7	1 hour	Perception Survey	SPQ	SPQ results

*GC – Guide card *AC – Activity Card *ASC – Assessment Card

Data Analysis

All data were collected and served as the basis to find out the effect of Strategic Intervention Material – Based Instruction on the learning approach and performance of students' in Chemistry. Data were tabulated, tallied, organized, statistically treated and analyzed.Using the Chemistry Learning Approach Inventory (CLAI) questionnaires, the researcher was able to classify students as to what learning approach they adopt before and after the implementation of the Strategic Intervention Material – Based Instruction (SIM – BI). The mean scores of the respondents in the CLAI was the basis for identifying their learning approach. Prior to the computation of the mean scores of the respondents, the

ratings given to negative items were subtracted from five. The total scores were added and the mean score was computed. Students with a mean score of ≥ 2.50 were classified as deep learners and those with a mean score of < 2.50 were classified as surface learners. The learning approach profile was presented using a pie chart.

The performance of the respondents was measured based on their scores in the Chemistry Achievement Test (CAT). Descriptive statistics was employed. Pretest and posttest scores of deep and surface learners were compared in terms of the highest and the lowest scores, mean scores, and standard deviation. The data were also used inferential statistics specifically t – test for dependent samples to find out if there is a significant difference in the performance of the respondents categorized as deep and surface learners evaluated at 0.05 level of significance. All data in the students' performance is presented in a tabular form.

Students' perception about the use of the SIM - BI was tabulated. The survey utilized scales from 1 – 4 with their equivalent remarks or descriptions. Frequency of responses by the respondents were tallied and presented also in tabular form. Weighted mean for each statement and the overall weighted mean were computed. This was done by adding product of the number of responses in each scale and divided by the number of respondents. The overall weighted mean was computed by getting the average of all the weighted means. Qualitative interpretations were based on the weighted mean computed using the ranges: 1 – 1.49 (Strongly disagree); 1.5 – 2.49 (Disagree); 2.5 – 3.49 (Agree); and 3.5 – 4.0 (Strongly agree). All data were fed into SPS version 11.0 statistical software.

Profile of Students in Chemistry

The Chemistry Learning Approach Inventory (CLAI) was given before and after the SIM - BI. The mean score of each student was the basis for classifying the learning approach the/she adopts in Chemistry. A mean score of ≥ 2.5 and < 2.5 classified the respondents as deep learner and surface learner respectively. Out of 80 respondents, 27 (33.75%) were classified as deep learners and 53 (66.25%) were categorized as surface learners before exposing the respondents to Strategic Intervention Material – Based Instruction (SIM - BI). It is evident that majority of the respondents adopted the surface approach in learning the subject area.

However, when students were exposed to SIM – BI, there is a change in the numbers of deep and surface learners. Prior to the implementation of the SIM – BI, majority of the respondents adopted the surface approach of learning. As revealed in figure 3, there is a change in the learning approach profile of the respondents. From 53 students adopting the surface approach it decreased to 24 after the SIM – BI. This indicates that 29 surface learners transformed into deep learners. Further, the number of deep learners increased by 29. These were the surface learners before SIM – BI. However, three deep learners before SIM – BI became surface learners after SIM – BI. These three students' were absent for 4

sessions during the duration of the study and they were not able to complete some activities in the SIM.

This result agreed with the statement of Biggs as mentioned in Daluz (2003) that approaches to learning are not necessarily exclusive. Students may adopt different approaches according to the tasks, the course or the teaching context. Learning approaches are not stable individual traits, although some students will tend toward taking a deep approach while others will tend taking toward surface approach. Biggs further stated that good teaching can motivate and influence students to change their learning approach from surface to deep approach of learning.It can be deduced that the changes in the learning approach from surface to deep approach transformed students from being passive to active, uncritical to critical thinker by examining facts and ideas, relating new to previous lessons and from showing disinterest to personal interest as mentioned in Miguel (2012) from the table of compilation of the characteristics of deep and surface learner by Biggs (1999) and Ramsden (1992).

The result also conformed with the statements of Biggs that good teaching served as encouragement of deep approach to learning. In the course of the study, the researcher observed that in completing the tasks or activities provided in the SIM - BI, respondents reviewed previous guide cards of the SIM that helped them answer the task of the day. In this case, students connected the previous to the present lesson which is an indicator of adopting the deep approach of learning.

Guide questions provided in the SIM were also considered by the researcher as one of the factors that transformed surface learner to deep learner. Guide questions under the guide cards and activity cards of the SIM were given higher points compared to the completion of tables. Students, therefore, are forced to read and comprehend every detail of this section of the SIM for them to answer and earn higher points.

Performance of Deep and Surface learners in the Chemistry Achievement Test (CAT) Before and After Exposure to SIM – BI. Performance of the students using different approach to learning was determined using the Chemistry Achievement Test which served as the pretest and posttest of the study. Table 3 gives the summary of the descriptive statistics of the pretest and posttest scores of the students in CAT in terms of mean scores, standard deviation, highest and lowest scores.

Table 3

Descriptive Statistics: Students' Pretest and Posttest Scores in CAT

	Deep Learners *(N=27)*				Surface Learners *(N=53)*			
	HS	LS	Mean	SD	HS	LS	Mean	SD
Pretest	12	5	8.85	1.99	14	7	9.75	1.84
Posttest	29	14	21.70	1.49	28	13	21.15	3.73
Gain Score	12.85				11.40			

The highest score in the pretest of the surface learners is 14 while the deep learners is 12. The highest score in the posttest of the surface learners is 28 while the deep learners is 29. Standard deviation shows that the scores in the posttest are more scattered around its respective mean from the pretest in both types of learners (deep: 1.99, 4.49; surface: 1.84, 3.73) From table 3, it can be noted that there was a considerable increase in the mean score of the two different types of learners after using the SIM in chemical bonding. Deep learners posted lower mean scores in the pretest compared to the surface learners with mean scores of 8.85 and 9.75, respectively. However, in the posttest deep learners registered a higher mean score with a slight difference than the surface learners. The latter obtained a mean score of 21.15 ;while, the former got 21.70. This implies that both deep and surface learners performed better when taught using the SIM - BI. Findings of this study confirm that findings of Togonon (2011) that SIM enhances students' achievement.

Comparison of the Means in the Pretest of Deep and Surface Learners

The respondents of the study were pretested to determine their prior knowledge on the subject matter before the SIM - BI. The table below shows the results of the pretest between the two groups of learners treated with independent t - test.

Table 4

Result of the t-test of the Pretest Mean Scores of the Deep and Surface Learners in the Chemistry Achievement Test (CAT)

Type of Learners	Pretest Mean	SD	*t* – value	*p* – value	Remarks
Deep Learners *(n = 27)*	8.85	1.99	1.97	0.055 *	Not Significant
Surface Learners *(n = 53)*	9.75	1.83			

p <0.05 * *equal variances not assumed*

The table above shows the mean scores in the pretest of deep and surface learners. The deep learners obtained 8.85 while the surface learners got a mean

score of 9.75. The standard deviations of the two scores are equivalent to 1.99 for the deep learners and 1.83 for the surface learners. The t-test for independent samples revealed a t-value of 1.97 and p – value of 0.055. The computed p-value associated with the test statistics is higher than the level of significance set in the study (p>0.05), therefore, the difference in the mean pretest scores of the two groups of learners is not significant. This result implies that at the start of the study, the prior knowledge of surface learners and deep learners are more or less comparable.

Comparison of the Means in the Posttest of Deep and Surface Learners

The same achievement test was used to determine the performance of the students after exposure to SIM - BI. Table 5 shows the results of the posttest of the two groups of learners treated with independent t – test.

Table 5

Result of the t-test of the Posttest Mean Scores of the Deep and Surface Learners in the Chemistry Achievement Test (CAT)

Type of Learners	Posttest Mean	SD	*t* – value	*p* – value	Remarks
Deep Learners *(n = 27)*	21.70	4.49	0.551	0.585*	Not Significant
Surface Learners *(n = 53)*	21.15	3.73			

p <0.05 * *equal variances not assumed*

The above table reveals the posttest mean scores of the deep and surface learners in the Chemistry Achievement Test (CAT. The deep learners obtained a mean score of 21.70 and 21.15 for the surface learners. Based on the mean score, it can be noted that deep learners got a higher mean score than the surface learners. The computed t-value is 0.551 and the p-value is 0.585. The computed p-value is greater than the level of significance set in the study (p > 0.05), thus, the difference is not significant. This indicates that the two types of learners performed equally well after SIM – BI. This also indicates that the Strategic Intervention Material is an effective instructional material for both types of learners. This result conformed with the statement of Ramsden as mentioned in Daluz (2003) that surface approach should not be viewed as a learning approach adopted only by weaker students and deep approach are for highly competent ones.

Comparison of the Pretest Mean and Posttest Mean of Deep and Surface learners

The mean difference between the scores in pretest and posttest in the Chemistry Achievement Test (CAT) was used to measure the knowledge gained by the respondents with the aid of SIM. Table 6 below summarizes the pretest and posttest mean scores of the two different types of learners using the t-test.

Table 6

T-test of the Pretest and Posttest Mean Gain of Deep and Surface Learners in the Chemistry Achievement Test

Type of Learners	Posttest Mean	Pretest Mean	Gain Score	*t*-value	*p*-value	Remarks
Deep Learner *(N=27)*	21.70	8.85	12.85	15.92	0.000	Significant
Surface Learner *(N=53)*	21.15	9.75	11.40	22.86	0.000	Significant

p <.05

The computation result indicated that there is a significant increase in the gain scores obtained by the deep learners which is equivalent to 12.85 points from the 21.70 and 8.85 mean scores of the posttest and pretest, respectively. The t-test for paired samples results to a t-value of 15.92 and a p-value of 0.000. This means that the difference between the posttest and pretest is significant.

In the same table, it is also shown that there is a difference between the pretest and posttest mean scores of the surface learners. Surface learners posted a gain score of 11.40 points. This gain score is considered significant based on the t-test results. The computed t-value and p-value are 22.864 and 0.000, respectively. The p-value is less than the level of significance set in the study ($p<0.05$), therefore, the difference between the mean scores in the pretest and posttest of the surface learners is significant. This could mean that both deep and surface learners exposed to SIM - BI achieved better. The findings also confirmed the findings of the studies done by Miguel (2012), Estacio (2008), and Soberano (2010).

In as much as the SIM - BI made use of a number of exercises, it could be speculated that the instruction had established a learning atmosphere suitable to the learning approach of the students. Furthermore, the presentation in the SIM - BI has motivating capabilities that demands attention and creates strong impact to the learners. The SIM - BI could provide effective communication and proper instruction matched with the learning needs of the students.

Students' Perception on the Use of the Strategic Intervention Material

Students' perception on the use of the SIM was gathered through the perception survey questionnaire. The survey consisted of 10 statements about the SIM and utilized a four - point rating scale with corresponding qualitative interpretations. It was given after the posttest of the study. Table 7 summarizes the results of the survey.

Table 7

Students' Perception on the Use of SIM

Statements	Rating				W.Mean	QI*
	1	2	3	4		
	frequency					
1. The SIM helps me understand how bonds are formed.	0	0	7	73	3.9	SA
2. The presentation of the concepts in the SIM is clear and fitted to my needs.	0	1	22	57	3.7	SA
3. I could easily understand the explanations provided by the SIM.	0	5	32	43	3.5	SA
4. I learn some useful information not mentioned in the regular teaching after using the SIM.	7	7	33	33	3.2	A
5. The time allotment is adequate for each lesson.	0	4	27	49	3.6	SA
6. Activities and tasks given in the SIM were very easy.	0	6	56	18	3.2	A
7. I enjoyed reading and doing all activities provided in the SIM.	0	2	24	54	3.7	SA
8. SIM use words and terms suited to my reading comprehension.	0	3	20	57	3.7	SA
9. SIM inspired and encouraged me to learn more topics in Chemistry.	0	0	32	48	3.6	SA
10. I want to use SIM in a regular classroom teaching next time.	0	1	15	64	3.8	SA
Overall Weighted Mean					3.6	SA

*Legend: SA – strongly agree; A – agree *QI – qualitative interpretation*

The table shows the frequency of responses of the respondents in each statement. Based on the result, the first question yielded the highest mean score 3.9 interpreted as strongly agree. Out of 80, 73 respondents responded strongly agree and 7 agreed that the SIM - BI helped them understand the lesson covered. The results indicate that SIM - BI is a useful teaching strategy, thereby, increasing the students' level of understanding as mentioned in Dy (2011).

Second in the rank is question number 10 with a mean rating of 3.8 (strongly agree). Majority of the sample strongly agreed that they want to use SIM not only for remediation purposes but in a regular classroom teaching. The high rating of this question can be attributed to the fact that the students enjoyed reading and doing all tasks and activities provided in the SIM as stated in question 8. Meanwhile, third among the perceptions with a shared mean rating of 3.7 were obtained by statements 2, 7, and 8. Respondents strongly agreed that the presentation of the concepts are clear and fitted to their needs, they enjoyed reading and doing all the activities, and the SIM used words that are fitted to their reading and comprehension ability. The concepts of chemical bonding in the SIM were designed by the researcher in a simple manner based on the

guidelines and principles on SIM construction set by the DepEd during seminars and contests.

Moreover, based on the experience of the researcher in the duration of the study, there were students who requested to bring home the SIM for them to answer the activities during Saturday and Sunday. These perceptions conformed with the study of Hamm (2009) that the reason for the transformation into deep approach adopted by the learners was that they had enjoyable and rewarding experiences. The remediation and transformation of 29 surface learners into deep learners may be attributed to this statement.

Next in the rank were statements number 5 and 9 with a mean rating of 3.6 (strongly agree) followed by question number 3 which obtained a mean rating of 3.5 (strongly agree). The fifth statement refers to the time allotment for each lesson. Students strongly agreed that adequate time was given to them to accomplish all activities or exercises in a given session. Statements 4 and 6 obtained the lowest mean rating of 3.2 (agree). Respondents agreed that they learned some useful information in the SIM not mentioned in a regular classroom teaching and activities and tasks given in the SIM made were easy. This lowest mean rating can be attributed to the nature of the SIM which is activity based compared to the regular classroom teaching which is a lecture based method, where all information about the topic are already given.
The overall mean rating of the respondents is 3.6 interpreted as strongly agree. This is an indication that the SIM is an effective tool in teaching to enhanced students performance and to improve their views about Chemistry.

Comments and Suggestions of Students Sample on the SIM
To further validate the result of the SPQ, comments and suggestions were gathered from the respondents. The extracts of the actual comments and suggestions from the respondents are presented in Table 8.

Table 8

Comments and Suggestions from the Respondents

Deep Learners	Surface Learners
"*I thought that the SIM (Strategic Intervention Material will be so hard to answer, but by analyzing the concepts I have learned something about specially chemical bonds. It is the hardest topic to me, but when our teacher gave us the SIM, learning that topic was easier*".	*" Im very happy because I learn more in chemistry. When I used SIM in the lesson I can easily answer all the questions in there. Im not bored anymore at least I enjoyed.*
" *SIM is very helpful to some students that cannot easily understand chemistry. I suggest that every students should answer SIM every Friday so that they will not forgot the lesson they discussed. SIM also help students to learn some of the certain topics and informotioned not mentioned in teaching*".	*" The Strategic Intervention Materials (SIM) help me to understand the explanation and the information help me in doing my activity"*
" *The SIM help me understand the topics given and it easily explain everything. I enjoyed answering specially the guide question*".	*" The SIM helps me understand some topics in Chemistry than before I did not understand".*
" I want to use the SIM because it is help me learn more and understand the topics and the difficult lessons".	*" I feel so happy because I learned how answered the SIM. I learned how to answering the SIM eventhough its hard".*
" The information applied in SIM is easier to understand than the teacher who's teaching infront of us. Because sometimes it is complicated".	" *For me using the SIM (Strategic Intervention Material) is very necessary and helpful for the students beCause it freshens up or recall the past lessons. I suggest that next time each semester or quarter should have SIM to help the students on their reviews".*

Based on the comments and suggestions of the respondents, the SIM really helped the students improve their performance in chemical bonding as one of the least mastered skills in Chemistry. Students are looking forward that SIM will also be given not only in Chemistry but also in other science subjects involving difficult topics. SIM must use words that are suited to the reading comprehension of the students that need remediation for a particular topic.

Conclusions and Recommendations

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

1. Most of the students adopted the deep learner's approach after the exposure to the SIM – BI. Some of the surface learners adopted the deep learner's approach while a few deep learners adopted the surface learners approach. The SIM – BI has capability of influencing the learning approach of the students in Chemistry.

2. The use of Strategic Intervention Material – Based Instruction (SIM – BI) enhances the performance of students in Chemistry regardless of learning approach adopted.
3. The deep and surface learners performed equally well after exposure to Strategic Intervention Material – Based Instruction (SIM – BI).
4. Deep and surface learners have a positive perception on the use of Strategic Intervention Material (SIM). Students find it enjoyable, interesting, and contributing positive attitude towards Chemistry.

Based on the findings of the study and conclusions drawn, the following are hereby recommended:
1. Use SIM – Based Instruction (SIM – BI) in other topics in Chemistry to further validate the result of the study.
2. Conduct a similar studies on the use of SIM – Based Instruction (SIM – BI) in other discipline to confirm the results of the study.
3. Use SIM as remediation material to enhance the achievement of surface learners.
4. Conduct further studies in SIM - BI using respondents in tertiary level to confirm its effectiveness in promoting deep learning approach and its applicability to Chemistry teaching.
5. Encourage administrators, science supervisors and teachers to make SIM in all topics not only the least mastered skills in a given subject area.
6. Teachers shall be provided with more seminars, workshops on the principles of SIM construction.

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