Reciprocal Teaching Approach with Self-Regulated Learning (RT-SRL): Effects on Students' Reading Comprehension, Achievement and Self-Regulation in Chemistry

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Abstract Reciprocal teaching is an interactive approach which provides students with reading strategies such as predicting, question generating, clarifying, and summarizing while self-regulated learning encompasses strategies which students use to achieve better learning outcomes. In this study, the effects of Reciprocal Teaching approach with Self-Regulated Learning (RT-SRL) to reading comprehension, achievement and self-regulation among nine graders in chemistry were investigated. The study utilized quasi-experimental pretest-posttest research design to a total of one hundred thirty one (131) nine graders from four intact sections in a public high school in Lopez, Quezon. In this study, purposive sampling was employed since the participants were not randomly assigned to groups and were already assigned to different class sections before the conduct of the study. Three validated instruments used in the study included: Reading Comprehension Test for assessing students' reading comprehension; Achievement Test for assessing students' achievement; and Self-Regulation Questionnaire (SRQ)

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for measuring students' self-regulation. Statistical results revealed that RT-SRL had significant effects on students' reading comprehension and achievement but had no significant effect on students' self-regulation in chemistry. Results also showed that students and teachers responded positively on the use of RT-SRL in learning and teaching chemistry, respectively. It is recommended that RT-SRL be employed in teaching science and chemistry in K to 12 curriculum.

Keywords: achievement, reading comprehension, reciprocal teaching (RT) approach, self-regulated learning (SRL), self-regulation

Introduction

Globally, the current advancements of science and technology in numerous fields are continuously contributing to the overall progress of many countries especially those, which are still developing. In order to sustain these trends, developing countries should invest in promoting quality education. In the Philippines, one of the government's priorities is the improvement of science and technology education thereby making science as one of the core subjects in all education levels. However, the Philippines ranked 41st and 42nd out of 45 participating countries in mathematics and science, respectively in the Trends in International Mathematics and Science Study (TIMMS) in 2003. This trend suggests that Filipino students have low mastery level in science and mathematics when they graduate in high school (TIMMS 2003: International Science Report, 2003). Moreover, Filipino students performed poorly in mathematics and science for the last decade despite of the country's higher literacy rate at 93.4% in 2008 based on the 2009 United Nations Development (UNDP) report (Tubeza, 2009). Recent National Achievement Test (NAT)

results released by the National Education Testing and Research Center (NETRC) and Department of Education (DepEd) for school year 2012-2013 showed that high school students obtained the lowest Mean Percentage Score (MPS) in science (41.35) among the other subjects (Education For All 2015 National Review Report: Philippines, 2015). The poor performance in science of Filipino students both globally and locally is alarming and the government should act responsibly in their educational reforms. Currently, the government's initiative of adopting the K to 12 curriculum in its educational system is expected to give positive results.

Amidst its desirable expected outcomes, the inclusion of the K to 12 curriculum brought about several challenges in secondary level. Although results of the study of Cabansag (2014) showed that participants had sufficient knowledge on the features of the K to 12 curriculum, Parra (2017) and Decena (2013) identified different challenges encountered in the implementation of the said curriculum in high school level. In the science of Grade 9 level, one major challenge was teaching using printed learning materials, which required students' reading comprehension. Moreover, Barton, Heidema and Jordan (2002) emphasized that the teachers' lack of effective approach in teaching with printed learning materials can cause students' difficulties in reading comprehension. Thus, finding an effective teaching approach using printed learning materials becomes imperative for science teachers.

Meanwhile, the Department of Science and Technology-Science Education Institute (DOST-SEI) and the Department of Education (DepEd) attributed the unsatisfactory performance of Filipino students in NAT to their poor reading comprehension (Rimando, 2006). Similarly, Imam, Mashira, Jamil, and Ismail (2014)-2004 reported that DepEd considered reading comprehension as a crucial factor

that causes students' low science achievement. Therefore, improving students' reading comprehension may be one of the means that can lead to their improved science achievement. Accordingly, results of the study of Imam (2016) showed that the only skill that predicted the overall science performance of all the participants in the study was understanding vocabulary in context. He emphasized that having a good vocabulary among students from both public and private schools may contribute to their higher MPS in NAT. In relation to the need of having good vocabulary, Kinniburgh and Shaw Jr. (2007) pointed out that students find it difficult to understand many concepts in science texts since it contains difficult academic vocabulary and ambiguous explanations. Maher and Salah (2008), even argued that comprehending a text, either in native or foreign language, is difficult if a reader had a poor vocabulary. Several studies have shown that vocabulary is a contributing factor to reading comprehension. Results in the study conducted by Gou (2008) showed that vocabulary knowledge showed significant effect on students' reading comprehension. Similarly, findings from the study conducted by Tannenbaum, Torgesen, and Wagner (2006); Gelderen, Schoonen, Glooper, Hulstijin, Simis, and Snellings (2004) and Snow (2002) revealed the strong relationship between reading comprehension and vocabulary.

Palincsar and Brown (1984) even claimed the effectiveness of their approach called reciprocal teaching (RT) in improving students' reading comprehension. The said approach actively involves the students as they use four reading strategies, which include making predictions, generating questions, giving clarifications, and creating summaries of what they read. According to Ahmadi (2012), predicting enables the reader to compare his background knowledge to the new data found in the text by referring to the textual clues such as headlines, titles, sub-titles and questions within the text. On the other hand, questioning about the text

enables the reader to develop the skill of formulating higher-order-thinking questions. Al Harby (2016) emphasized that in the clarifying phase, students inquire about difficult or unfamiliar concepts and terminologies in the text using a dictionary and they looked for contextual clues, to overcome those obstacles hindering them from comprehending the text. Lastly, Al Harby added that summarizing enables the reader to determine the text's major ideas to make some kind of integration among elements of information in the text through realizing relations within it.

Several studies showed that RT approach resulted to significant improvements in students' reading comprehension. Results from the studies by Bess (2007), Sporer (2009) and DiLorenzo (2010) showed that students who practiced RT strategies improved their reading comprehension. Similarly, Al-Makhzoomi and Freihat (2012) and Hou (2015) showed the effectiveness of RT on improving students' reading comprehension where they also gave positive responses.

Several studies have also shown that Self-Regulated Learning (SRL) strategies were effective in enhancing students' reading comprehension. SRL is described in terms of learners who actively participate in their own learning process using strategies to achieve their academic goals (Zimmerman, 1989). Students' use of SRL strategies as reported by James (2012) positively correlated with reading comprehension. Similarly, Yigzaw and Fentie (2013) showed that SRL strategies such as reviewing and remembering, explaining, unifying and transforming had significant effect on students' reading comprehension. Maftoon and Tasnimi (2014) suggested that SRL strategies such as environmental structuring, organizing and transforming, goal setting and planning, keeping records and monitoring, seeking social assistance, rehearsing and memorizing, reviewing records and self-consequating affected students' reading comprehension.

Furthermore, SRL strategies were also found effective in enhancing students' achievement. Nwafor, Chikaodinaka and Okafor (2015) revealed that the use of SRL strategies resulted to higher achievement of students in basic science than the conventional method. Fouché (2013) studied the effect of students' use of strategies of SRL, which includes evaluating their own performance on their achievement in Grade 9 physics, showing that they improved their achievement on the said subject.

Several studies showed the effectiveness of RT approach and of SRL in enhancing students' reading comprehension and achievement, which means that RT is not sufficient to define significant improvements in reading comprehension and achievement. Furthermore, SRL strategies can also improve students' self-regulation. However, few teachers employ effective approaches like SRL to promote the development of self-regulation among their students. Thus, this study employed Reciprocal Teaching approach with Self-Regulated Learning (RT-SRL) to investigate its effect on reading comprehension, achievement, and self-regulation in chemistry. The combination of RT approach and SRL in this study strengthened its purpose to address students' difficulties in comprehending science texts specifically in chemistry which could also lead to the improvement of students' achievement on the said subject. Furthermore, it could develop students' self-regulation which could also improve their reading comprehension and achievement in chemistry.

Framework of the Study

Palincsar and Brown (1984) who first introduced RT discussed its theoretical bases as centered on two principles influenced by Vygotsky's social development theory. These principles are "proleptic" teaching and expert scaffolding, which are parts

of Vygotsky's "zone of proximal development." "Proleptic" in proleptic teaching means "in anticipation of competence" where Palincsar and Brown believed that a learner could engage in RT at his own pace if the teacher provides sufficient support until the learner develops reading comprehension skills. On the other hand, Palincsar and Brown stressed that expert scaffolding is crucial to the successful implementation of RT, which is described as the difference from the point students learn solving problems independently to the point they learn solving problems with their peers. They described expert scaffolding as a method where the teachers provide support and guidance to their students until they develop the necessary skills for learning.

Moreover, this is study also based on SRL by Zimmerman (1989) referring to its strategies ,which students use to achieve their academic goals. SRL relates to Bandura's triadic model of self-regulation, which are composed of three components such as person, environment and behavior, influencing each other reciprocally through the use of strategy and response by learner. The main core of Bandura's theory describes that, behavior of an individual depends on the interaction of influences originated within the individual (self) and from his external environment. Furthermore, Bandura believed that people think and act based on the interaction of how an individual does the following tasks: 1) evaluating one's self; 2) responding by one's self; and 3) observing one's self (Zimmerman, 1989).

The principles of "proleptic" teaching and expert scaffolding presented in Vygotsky's social development theory formed the basis of methods employed in Palincsar and Brown's RT approach. In relation to learning, they designed the said approach to improve students' reading comprehension. Apparently, the principles in Bandura's triadic model of self-regulation as part of his social cognitive theory formed the basis of the SRL strategies proposed by

Zimmerman (1989), which promote self-regulation. Based on these principles, the study worked on the framework as shown below.

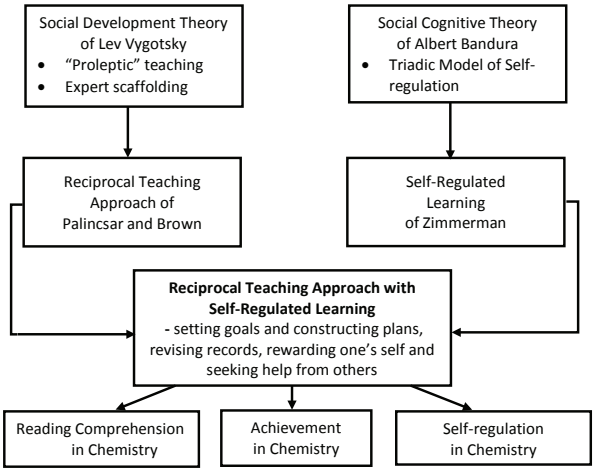

Figure 1. Framework of the Study.

Based on Figure 1, "proleptic" teaching and expert scaffolding as influenced by Vygotsky's social development theory relates to RT while the triadic model of self-regulation from Bandura's social cognitive theory relates to SRL strategies. Adopting Palincsar and Brown's RT and Zimmerman's SRL and its four strategies (setting goals and constructing plans, revising records, rewarding one's self and seeking help from others), the researchers utilized RT-SRL to improve students' reading comprehension, achievement and self-regulation in chemistry.

Purpose of the Research

Thus, the research study investigated the effects of RT-SRL on the reading comprehension, achievement and self-regulation of Grade 9 students in chemistry. Specifically,

the study would like to determine if there exists a significant difference across the pre-test and post-test scores in reading comprehension, achievement and self-regulation in chemistry among students who were exposed to RT-SRL.

Methodology

Research Design

The study employed quasi-experimental pre-test-post-test design to investigate the effects of RT-SRL on the reading comprehension, achievement, and self-regulation of Grade 9 students in chemistry.

Participants and Locale

Seven hundred eighty Grade 9 students enrolled in a public high school at the municipality of Lopez, Quezon province represented the population of the study. In this study, purposive sampling was employed wherein one hundred thirty one (131) students from four intact class sections were selected as participants. These students were exposed to RT-SRL to ensure that they were not deprived of the said intervention. The study was conducted on the second quarter, from the month of August to second week of October, school year 2016-2017.

Instruments

Three instruments were used in this study and were administered to the participants as pre-tests and post-tests, which included reading comprehension test to measure their reading comprehension in chemistry, achievement test to measure their achievement in chemistry and SRQ to measure their self-regulation in chemistry. Also, RT-SRL package was used in the study to aid the students in applying RT-SRL as the study's intervention in learning chemistry lessons.

Reading Comprehension Test (RCT)

This researcher-made test was based on the constructed Table of Specifications (TOS) which is aligned to the learning competencies of Grade 9 Science Curriculum in chemistry. The test consists of six reading passages, which were taken from textbooks and websites relevant to the topics in chemistry included in Science 9 Learners Material and were modified to suit the study. Three to five multiple-choice questions were included after each passage with a total of 22 items. The computed Cronbach alpha value for reading comprehension test is 0.72 rated as acceptable.

Chemistry Achievement Test (CAT)

This researcher-made test was used both as the pre-test and post-test. It consists of 35 multiple-choice questions covering the selected topics in chemistry included in the four learning modules of Science 9 Learners Material focused on electronic structure of matter, chemical bonding, organic compounds and mole concept which were taken up during the second quarter. The computed Cronbach alpha value for this test is 0.67 rated as acceptable.

Self- Regulation Questionnaire (SRQ)

This questionnaire developed by Brown, Miller and Lawendowski (1991) was used in this study to assess students' self-regulation in chemistry. The SRQ has an internal consistency reliability for both the pretest and posttest with acceptable values of 0.710 and 0.737, respectively.

RT-SRL Strategy Package

An RT-SRL strategy package was utilized by two selected science teachers and their students in learning the strategies contained in the Reciprocal Teaching approach with

Self-Regulated Learning (RT-SRL). This package contains a brochure of RT-SRL, RT worksheet, RT prompt card, and RT rubric. The researcher-made RT-SRL strategy package was aligned to the instructional procedure of RT approach by Palincsar and Brown and the inclusion of the strategies of self-regulated learning was based on Zimmerman's proposed self-regulated learning strategies.

Data Collection

Pre-Implementation

Before the implementation of intervention of the study, the researchers had sought the permission of the Division Superintendent and the School Principal regarding the participation of selected four class sections in the study. The participants were also told that they were involved in the study through the consent letter and informed consent forms which were given to them.

Then, pretests of research instruments were administered to the participants. The SRQ was administered to the Grade 9 students as a pre-test on the second week of June of the school year 2016-2017. Then, the Chemistry Achievement Test was administered as a pre-test on the first week of August. Lastly, after one-week break, the students also answered the Reading Comprehension Test.

Implementing the Intervention of the Study

The researchers selected two Grade 9 Science teachers to participate in the study and conducted orientation to the selected teachers regarding the application of the treatment in the study. The orientation included a discussion on RT-SRL and how it would be employed through the RT-SRL Strategy Package, which was also distributed to them. In addition, selected teachers were also given researcher-made

detailed lesson plans and reading comprehension materials which they used in teaching chemistry lessons.

The flowchart below shows how RT-SRL was employed which consisted of the following stages: (1) direct instruction and modeling of RT-SRL; (2) guided practice and expert scaffolding in students' use of RT-SRL strategies; and (3) application of RT-SRL in teaching chemistry.

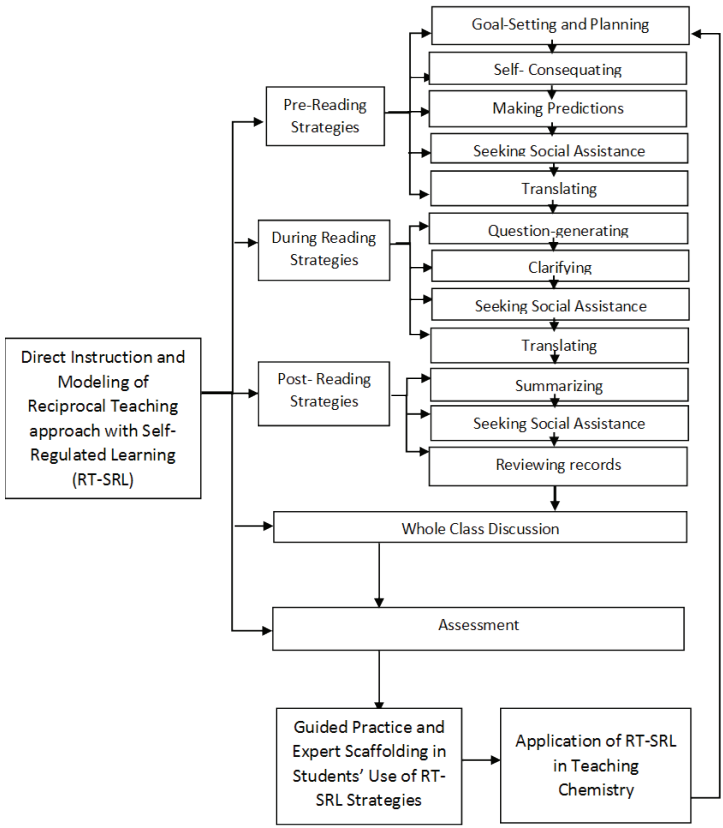

Figure 2. Flowchart of Employing the RT-SRL in the Study.

In the first stage, a combination of RT and SRL strategies were used by students in the pre-reading, during reading and after reading stages. The RT strategies included making predictions, question-generating, giving clarifications and creating a summary. Among the fourteen types of SRL strategies by Zimmerman (1989), four were adopted, which included setting goals and constructing plans, rewarding one's self, seeking help from others and revising records. In addition to these strategies, the researcher used translating as a students' option where they can talk with their teacher or classmates using their mother tongue. The choice of this strategy is based on the principle of "proleptic" teaching adopted by Palincsar and Brown in their RT approach. After employing all these strategies, the teacher facilitated the whole class discussion where the students presented their predictions, questions, clarifications and summaries of the reading material. These were all written in their RT worksheets. The teacher used the RT rubric in students' presentation. Then, formative assessment was administered to the students to evaluate their understanding of the reading material. In the second stage, guided practice and expert scaffolding were given to the students in the use of RT strategies and SRL strategies. Guided practice and expert scaffolding were part of the instructional procedure of RT. In the third stage, RT-SRL strategies were applied in studying their chemistry lessons.

Below is a table showing the RT-SRL strategies used by students in studying their chemistry lessons.

Table 1. RT-SRL Strategy used based on the Learning Competencies in Chemistry

Learning Competencies in Chemistry	RT-SRL Strategy Used	Number of days per week
1. Describe Bohr's Model of the atom as it improved Rutherford's Atomic Model 2. Describe the behavior of the electrons inside the atom based on Bohr's atomic model	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	2
1. Recognize the physicists who contributed on the idea about the atomic structure 2. Explain how the Quantum Mechanical Model of the atom describes the energies and probable positions of the electrons	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	
1. Differentiate ionic bonds and covalent bonds based on their formation and examples 2. Differentiate polar and nonpolar covalent bonds based on their formation and examples	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	2
1. Explain the properties of different types of compounds (ionic or covalent/molecular) such as melting point, hardness, polarity, electrical and thermal conductivity 2. Explain the properties of metals in terms of their properties and structure 3. Infer which property of metals is being described based on examples	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	2
1. Recognize the general classes of organic compounds based on their composition, properties and uses 2.Recognize different examples of the general classes of organic compounds based on their uses	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	2
1. Recognize the description of a mole as a unit for amount of substances or number of particles 2. Interpret a given data relating the number of particles and its masses. 3. Execute calculations involving number of moles, molar mass and Avogadro's number of particles	**RT approach strategies:** predicting, questioning, clarifying and summarizing **SRL strategies:** setting goals and constructing plans, rewarding one's self, seeking help from others and revising records	2

Post Implementation

After six weeks, students were given the same reading comprehension test, achievement test, and SRQ as post-tests. The reading comprehension test was administered first followed by the achievement test on the next day and lastly the SRQ was given after. The data collected were subjected to statistical analysis.

Data Analysis

In relation to the research question, repeated measures MANOVA was used to determine the significant improvement from pretest to posttest scores across reading comprehension, achievement, and self-regulation in chemistry among students who were exposed to RT-SRL. Also, thematic analysis was employed to identify themes or trends, on the implementation of RT-SRL among selected teachers and students.

Results and Discussion

This section presents the thematic analysis on the observations conducted on students' use of RT-SRL when they learned chemistry lessons and on teachers as facilitators of the said intervention. The students worked in small groups wherein each group is provided with copies of the reading material in their chemistry lesson and RT-SRL Package materials to aid them in applying the intervention.

Activating students' mind through strategic reading and learning using Reciprocal Teaching approach with Self-Regulated Learning (RT-SRL).

Table 2. Observation on Students and Teachers during the Three-stage Implementation of RT-SRL

Stages	Observations
1. Direct instruction and modeling on students	1. The students showed interest in listening to their teachers when they discussed to them what RT-SRL is all about and how their students will apply this intervention in learning their chemistry lessons. 2. The students observed their teachers while modeling how each strategy should be used while they read and study the written materials containing their chemistry lessons.
2. Guided practice and expert scaffolding on students	1. The students were actively involved while they worked in small groups. Each member of the group was performing their assigned role such as predictor, questioner, clarifier and summarizer and a leader to facilitate the employment of SRL strategies. 2. The teachers consistently checked on them while they were engaged in reading the material through the use of the strategies in the RT-SRL.
3. Application of RT-SRL	1. The students were actively engaged during the pre-reading, during reading and post-reading activities while using the RT and SRL strategies in learning their chemistry lessons. 2. The teachers acted as facilitators while their students were performing their reading activity.

Table 2 shows the general observations on students and teachers during the implementation of the intervention-RT-SRL. It can be noticed that students were enthusiastic in learning the said intervention during the direct instruction and modeling of RT-SRL. Moreover, it can also be inferred that students were responsive while their teachers provided adequate support and guidance during the guided practice and expert scaffolding stage. Lastly, it can be seen that the students showed active participation and independent

learning while their teachers as facilitators transferred the responsibility of learning to their students.

This section also presents the quantitative data analysis of students' pre-test and post-test scores in reading comprehension, achievement and self-regulation in chemistry using repeated measures MANOVA.

Repeated-Measures MANOVA (GLM Repeated Measures)

Table 3. Multivariate Tests on Students' Reading Comprehension, Achievement and Self-Regulation in Chemistry

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's trace	.752	81.816[a]	3.000	81.000	.000	.752
Wilks' lambda	.248	81.816[a]	3.000	81.000	.000	.752
Hotelling's trace	3.030	81.816[a]	3.000	81.000	.000	.752
Roy's largest root	3.030	81.816[a]	3.000	81.000	.000	.752

Each F tests the multivariate effect of Time. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

Table 3 shows the results of multivariate tests for the three variables under study. Since the significance is less than .05 for all the Multivariate Tests, these results mean that reading comprehension, achievement test, and self-regulation have changed over the course of time between the pretest and the posttest. In addition to the multivariate tests, tests of within-subjects contrasts were also employed to compare the pretest and posttest scores on reading comprehension, achievement and self-regulation of students.

Table 4. Tests of Within-Subjects Contrasts for Reading Comprehension Test, Achievement Test and Self-Regulation Test.

Source	Measure	Time	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Time	Reading comprehension	Level 1 vs. Level 2	629.762	1	629.762	51.946	.000	.385
	Achievement test	Level 1 vs. Level 2	3012.012	1	3012.012	239.693	.000	.743
	Self regulation	Level 1 vs. Level 2	377.190	1	377.190	1.533	.219	.018
Error(Time)	Reading comprehension	Level 1 vs. Level 2	1006.238	83	12.123			
	Achievement test	Level 1 vs. Level 2	1042.988	83	12.566			
	Self regulation	Level 1 vs. Level 2	20416.810	83	245.986			

** significant @p < .05*

Table 4 shows the results of tests of within-subjects contrasts. Repeated contrasts were analyzed comparing the reading comprehension, achievement and self-regulation for pretest and posttest. The contrasts for reading comprehension and achievement test are both significant, $p< 0.001$, while the contrast for self-regulation is not significant with $p=0.219$. These results indicate that RT-SRL has significant effect on reading comprehension and achievement test but not on self-regulation.

Table 5. Estimated Marginal means for Reading Comprehension Test, Achievement Test and Self-Regulation Test

Measure	Time	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Reading comprehension	1	8.786	.269	8.250	9.322
	2	11.524	.349	10.830	12.218
Achievement test	1	10.321	.294	9.736	10.907
	2	16.310	.397	15.520	17.100
Self- regulation	1	204.833	1.501	201.848	207.819
	2	206.952	1.764	203.444	210.460

Table 5 shows the means of students' pretest and posttest scores. On the average, it can be noticed that reading comprehension, achievement test, and self-regulation tend to increase over time, before and after the intervention. However, it is worth noting that the average increase in self-regulation (1.03%) is not that substantial as compared to reading comprehension (31.16%) and achievement test (58.03%).

Results from the thematic analysis showed that the students and teachers responded positively on RT-SRL. Students and teachers showed interest in using RT-SRL as they engaged in active reading and teaching their students on the procedures of employing RT-SRL, respectively. Students also showed responsibility over their learning as they performed certain roles in using RT-SRL strategies while the teachers showed support and guidance on students' learning. These results can be supported by the following literature. Bottomley and Osborn (1993) cited the positive outcomes of employing RT where the teachers were enthusiastic in employing the said approach. Data analysis in the study of Bess (2007) showed the increase in students' active participation during reading group discussions using RT approach. Sporer (2009) reported that students who used RT found it challenging but useful for improving reading comprehension. Choo, Eng, Ahmad (2011) qualitative analysis on the effects of RT cited that experimental group gave positive feedback.

Results using repeated measures MANOVA also showed that RT-SRL had significant effects on the reading comprehension and achievement test, but not on self-regulation. Larger effect was on achievement test as can be seen on the mean increase from pretest to posttest among the students. These findings add to the literature on RT approaches positive effect on scientific literacy (Di Lorenzo, 2011) and reading comprehension (Ahmad, et al., 2011; Al-Makhzoomi and Freihat, 2012; Hou, 2015).

On the other hand, different results were observed for self-regulation which showed no significant improvement for students based on their mean pretest and posttest scores. Zimmerman, Bonner and Kovach (1996) claimed self-regulation can be developed when students exert their efforts, devote more time and energy and when students are benefited from it. Results in the study of Cho (2004) suggested that SRL strategies are not developed instantly by instructing the students to practice them during classes. Furthermore, Cho emphasized that students will not develop self-regulation by just exposing them to strategies promoting it. Instead, they should consistently interact with their teachers or other students to check on how they improve their self-regulation. Lastly, the study recommended that students should be trained to be independent and responsible for them to develop their self-regulation while they are practicing the strategies promoting it. In relation to the study, students were instructed to practice eight strategies embedded in RT-SRL, which means four strategies of RT and another four strategies of SRL. Teachers and students interviews indicated that practicing all the eight strategies from RT and SRL had been a difficult task for the students due to shorter duration. Since the four RT strategies were consistently used in studying the lessons, the remaining four SRL strategies were not adequately applied by the students throughout the study.

Moreover, Boekaerts and Cascallar (2006) emphasized that the time allocation in training the students on the use of SRL strategies is crucial in developing students' self-regulation. Dignath and Büttner (2008) perceived that longer interventions are more effective both for primary and secondary school levels. They claimed that students' self-regulation is enhanced as students increase their experience in practicing the strategies over time. Thus, longer time periods should be spent for interventions using SRL strategies to promote self-regulation.

Conclusion

The main objectives of the study were to investigate the effects of RT-SRL on the reading comprehension, achievement and self-regulation among Grade 9 students in chemistry and to determine trends or themes which describe how students and teachers responded on the employment of RT-SRL in learning and teaching chemistry, respectively. Although previous studies have already established the effectiveness of RT and SRL in improving students' reading comprehension and achievement in different learning areas, there were very few studies which investigated its effects on reading comprehension and achievement in science especially in chemistry. The effectiveness of RT-SRL in improving reading comprehension as shown in this study can address the problem on lack of effective approach in teaching with printed learning materials which required students' reading comprehension. Also, RT-SRL can be an effective contributing factor in enhancing students' achievement in local and foreign achievement tests where Filipino students showed poor performance since some literature claimed that students' poor reading comprehension caused their low science achievement. Thus, the effectiveness of RT-SRL in improving reading comprehension and achievement could then improve students' performance in national and even in international achievement tests in science.

Results from thematic analysis revealed that students and teachers exhibited positive responses towards the implementation of the intervention-RT-SRL. Moreover, results from repeated measures of MANOVA showed that there are significant effects on students' reading comprehension and achievement in chemistry after they were exposed to RT-SRL. However, results showed no significant effect on students' self-regulation. Based on the results, the study has positive implications on the use of RT-SRL in chemistry teaching as it resulted to significant improvements on students' reading

comprehension and achievement after they were exposed from the said intervention. These imply that RT-SRL is effective in enhancing students' reading comprehension and achievement in chemistry. In relation to this, RT approach was designed by Palincsar and Brown (1984) to improve students' reading comprehension through the use of reading strategies such as predicting, questioning, clarifying and summarizing. On the other hand, the effectiveness of SRL strategies in improving students' reading comprehension and achievement is based on Zimmerman's SRL strategies which were proposed to provide the learners with strategies which they can use in achieving their academic goals. In relation to students' self-regulation in chemistry, the results showed no significant improvement which implies that RT-SRL was not effective in improving students' self-regulation in chemistry. Accordingly, one factor which might have hindered its improvement is the duration of implementing RT-SRL. Thus, teachers should allocate intensive and consistent sessions of the intervention during science or chemistry instruction emphasizing the use of SRL strategies and not only the RT strategies embedded on RT-SRL. Instead of allocating only two sessions on employing RT-SRL every week, a science teacher may consistently employ it for three to four sessions where students will have more time to practice SRL strategies.

The combination of RT and SRL as a unified approach which was used in this study to teach chemistry lessons introduced an innovative teaching approach which uses strategies in reading and learning chemistry. Students' use of RT-SRL strategies while reading and learning their chemistry lessons taught them to be active rather than passive learners. Furthermore, the positive responses given by teachers and students on RT-SRL as an effective approach can be a basis for innovating similar teaching approaches which employ different strategies which promote active reading and learning among students. Also, the use of RT-SRL can work

hand in hand with laboratory experiments usually employed in teaching science and chemistry thereby strengthening students' learning of the said content learning areas.

Overall, the results of the study showed the effectiveness of RT-SRL in improving students' reading comprehension and achievement in chemistry suggesting possible future applications of the said approach in teaching science and chemistry in K to 12 curriculum.

Recommendations

In view of the findings and conclusions formulated in the study, it is recommended that teachers may think and design effective teaching approaches like RT-SRL which are student-centered, can stimulate more thinking in their students, can develop 21st century skills and can cater lifelong learning which are in lined with K to 12 goals. For future researchers in science education, it is recommended to replicate this study covering larger scope in chemistry and in Biology, Physics and Earth Science or other subject areas. In relation to assessing students' self-regulation, researchers may employ another method like the use of reflective journal of students to assess their self-regulation. Researchers may also investigate on the effects of RT-SRL on students' communication skills in relation to the instructional methods employed in RT approach. Lastly, it is also suggested for them to consider conducting other studies related to teaching approaches which aim to improve students' reading comprehension and achievement in science. Furthermore, the school administrators may consider the conduct of training for science teachers and other teachers in the implementation of RT-SRL in the classroom. Lastly, curriculum developers may develop printed materials in chemistry or science lessons which can help the students to easily comprehend these lessons and can enhance their reading comprehension and achievement in chemistry or science.

Although this study produced significant improvements on students' reading comprehension, achievement in chemistry except in self-regulation, there are also limitations to this study. One limitation is the research design used which is quasi-experimental design. According to Mertens (2005), many studies in education use quasi-experimental design because it is difficult to employ random assignment since most classes are already created. Consequently, this was the case in the study site wherein students were already assigned to different class sections before the conduct of the study. Another limitation is the duration of RT-SRL as intervention. Instead of allocating only two sessions on employing it every week, a science teacher may employ it for three to four sessions where students will have sufficient time to practice SRL strategies.

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