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Abstract

One of the important decisions a teacher has to make is to choose specific teaching method that would best achieve lesson objectives and ensure effective learning to take place among students. The use of active strategies among college students is said to promote higher achievement among students. One of these methods is self-regulated learning. This research aimed to investigate the effectiveness of self-regulating learning (SRL) method in relation to student's motivation and use of learning strategies and students' achievement in Biological Science. The study used a pretest-posttest design. One intact class was used with 39 students. Teacher-made achievement test, course teaching manual, course reader and Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich et al (1991) were used in the study. Results revealed that SRL method increased students' achievement in Biological Science. Results on MSLQ revealed no significant differences between the mean scores of students. MSLQ Motivation and Learning Strategy scales showed no significant relationships with achievement score. SRL method sustained students' motivation and use of self-regulated learning strategies towards learning Biological Science. Findings of the study may provide implications on the use of active strategies that could effectively teach Biological Science among college students.
Keywords: Education, College Science Teaching, Self-Regulated Learning, Pretest-Post Test Design, MSLQ

Introduction

One of the important decisions a teacher has to make is to choose specific teaching method that would best achieve lesson objectives and ensure effective learning to take place among students. One of these methods is self-regulated learning. Self-regulated learning is described by Pintrich (2000) as: "an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation and behavior, guided and constrained by their goals and the contextual features in the environment" (p. 453). Paris and Paris (2001) mentioned that SRL "emphasizes autonomy and control by the

individual who monitors, directs, and regulates actions toward goals of information acquisition, expanding expertise, and self-improvement" (p. 89). Boekarts, Maes, and Karoly (as cited in Garner, 2009) added that SRL includes management of cognitive and affective aspects of learning, including strategy use and motivation.

There are various researches conducted on different aspects of self-regulated learning. At present, the study of self-regulation and SRL continue to expand to various aspects of learning and fields of studies. Paris and Paris (2001) mentioned several researches published that were directly related to SRL. Examples of these include phenomenological aspects of SRL (Mc Combs & Marzano 1990), children's social regulation (Patrick 1997), family influences on self-regulation (Grolnick et al., 1999), social and cultural influences on SRL (Boekaerts, 1998; Pressley, 1995), monitoring reading (Pressley and Ghatala, 1990), personal cognitive development (Ferrari and Mahalingam 1998), and specific influences of situation and domain knowledge on SRL (Alexander 1995). Recent studies include the investigation of SRL in various fields such as mathematical E-learning environments (Kramarski and Gutman, 2006), hypermedia (Azevedo, 2005), computer-based instruction (Perry and Winne 2006), among elementary student teachers (Young and Vrongistinos, 2002) and sample of adolescent males (Effeney et al., 2013).

Conducting studies on SRL among college students is supported by the idea that SRL is appropriate for college students for they have great control of their own time schedule, and how they approach their studying and learning (Pintrich, 1995; Chye et al., 1997).

Young and Konstantinos (2002) have mentioned a number of studies indicating the relation of SRL to certain aspects of learning. These studies include: SRL is highly related to quality learning, performance, and positive academic outcomes (Ames, 1984; Borkowski and Kurtz, 1987; Corno, 1986, 1989; Covington, 1987; Dweck, 1986; Paris and Oka, 1986; Patrick, 1998; Wang and Peverly, 1986; Zimmerman, 1989; Zimmerman and Martinez-Pons, 1986, 1990); high academic achievers were more likely to use SRL strategies such as goal-setting, selecting strategies, and monitoring performance than low-achieving students (Das et al., 1995; Naglieri and Das, 1990); students who were reported to use greater SRL strategies were also high academic achievers and high academic achievers optimized motivational, metacognitive, and environmental resources such as seeking peer/adult help to achieve their goals (Zimmerman and Martinez-Pons, 1986). Likewise, studies of Schunk (1989) and Zimmerman and Martinez-Pons (1992) reported that learners' use of self-regulation strategies sustains efforts and promotes academic achievement.

Assessing college students' self-regulated learning can be measured by certain instruments. The widely used instrument in researches concerning self-regulated learning is the Motivated Strategies for Learning Questionnaire (MSLQ) (Chen, 2002). This questionnaire is developed by Pintrich et al (1991) and is used to assess participants' motivational orientations and their use of different learning strategies toward the specific course under study with reference to the class from which the participants are be taken.

Cobb (2003) mentioned that researchers express some disagreements as to whether self-regulated learning is a broad, general process that can be applied in any learning situation (Corno et al., 1982) or a context specific heuristic (Pintrich and Garcia, 1991) which changes with each learning situation. The reported disagreements on the use of self-regulated learning and the continuous challenge of deciding which teaching method will keep students motivated and

ensure effective learning to take place, make it important to study the effects of SRL on achievement among college freshmen students in the context of teaching Biological Science. Findings of the study along with understanding of how students regulate their learning, may provide implications on the use of strategies that could effectively teaching Biological Science among college students.

Framework

This study was anchored on Piaget's Theory of Cognitive Development and Albert Bandura's social cognitive theory. SRL method is centered on the development of self-regulation within each student. This is supported by Piaget's Theory of Cognitive Development that emphasizes that the heart of learning is self-regulation or equilibration, in which learning occurs through an individual's active interaction with the environment.

Social Cognitive Theory by Albert Bandura is related to Piaget's Theory of Cognitive Development. Bandura's theory advocates triadic reciprocal determinism of personal, behavioral, and environmental factors affecting the functioning of each individual (Zimmerman 1989). Bandura emphasized that in reciprocal determinism, these three factors, exert regulatory influence controlling personal, behavioral, and environmental processes. The behavior of an individual is a product of interaction of both personal and environmental factors.

Objectives of the Study

The study attempted to investigate the effect of SRL method in relation to college students' motivation and use of learning strategies and students' achievement in Biological Science. Specifically, it sought to compare the Biological Science and MSLQ mean pretest and posttest scores of students exposed to SRL method.

Methodology

Research Design

This quantitative research made use of pretest-posttest design. In the pretest-posttest design, the group was measured or observed twice. Pretest serves as the first measurement, and the second is the posttest (Frankael & Wallen, 2007).

Participants

The participants of this research were 39 freshmen college students enrolled in Bachelor of Secondary Education (BSED) program taking up Biological Sciences in a state university in Tacloban City, Leyte, Philippines. All students in the selected section were all taken as participants in the study. Each class meeting was conducted for one hour and thirty minutes during Monday and Thursday. The time duration for each topic was based on the time allotment as stated in the course outline. The study was conducted for one entire semester, a period of five months.

Instrumentation

Teacher-made test. Student's achievement in Biological Science was measured using a 75-item multiple choice teacher-made test, which was given as both pretest and posttest. This test was used to determine students' understanding of concepts in Biological Science. This underwent the

process of validation and reliability test. Table of specification was used and the test was shown to researcher's colleagues who have been teaching Biology for five years or more for critiquing and comments, particularly in terms of content validity, distribution and appropriateness of the test items. It was also tried out to students who already took Biological Science. From the comments and the results of the try-out, the test was revised and reduced to 75 items in its final form. The reliability coefficient was computed using the Kuder-Richardson formula (KR20), which according to Zafar (2008), KR-20 index is the appropriate. The computed index value was found to be 0.919.

Course Reader. The Course Reader was designed by the researcher as a resource material for Biological Science. It served as an easy reference for the students. It underwent validation. It was shown to the researcher's colleagues who had been teaching Biology for five years or more for critiquing particularly in terms of content validity. A rating sheet for evaluating the material was used by the evaluators.

Course Teaching Manual. This researcher made manual was designed as a guide in teaching lessons in Biological Science using SRL strategies. This also underwent validation in the same manner the course reader was validated. The design was based on the major characteristic of self-regulated learning wherein students are given autonomy on demonstrating their own learning. The lesson was taught in such a manner that students were given the autonomy to choose their own strategy in showing their understanding of the concepts of specific lessons as guided by the objectives for each learning session. The sequence and time allotment for the lessons were based on the Biological Science syllabus. It was conducted following the steps: introduction to the lesson or motivation; presentation of objective; learning activities, generalization or summary; evaluation, and assignment.

Motivated Strategies for Learning Questionnaire (MSLQ). This questionnaire is widely used in researches concerning self-regulated learning. This was developed by Pintrich et al (1991) to assess participants' motivational orientations and their use of different learning strategies toward the specific course under study with reference to the class from which the participants will be taken. This is also widely used instrument to assess college students' self-regulated learning (Chen, 2002).

The questionnaire is composed of 81 items divided into two sections. The motivation section, composed of 31 items, assesses academic goal orientation and affective variables that are known to influence the likelihood of strategy use and type of attributions made following academic success or failure. The learning strategies section includes 31 items that assess students' use of different cognitive and metacognitive strategies and also 19 items assessing student management of different resources. A seven-point Likert scale ranging from 1 (not at all true to me) to 7 (very true of me) was used by students rate themselves in every item. The different items are further grouped into 15 subscales. Subscales for motivation section includes: control over learning beliefs, extrinsic goal orientation, intrinsic goal orientation, performance, self-efficacy for learning, task value, and test anxiety. Learning strategies subscales include: critical thinking, effort regulation, elaboration, help seeking, metacognitive self-regulation,

organization, peer learning, rehearsal, time and study environment management. The instrument takes approximately 20-30 minutes to answer. MSLQ's validity and reliability has been documented (Pintrich et al., 1991).

Despite published claims of reliability and validity for the original instrument, however, the questionnaire was pilot tested to 20 Filipino college students to establish validity and reliability of the MSLQ instrument in the English version among Filipino students. The questionnaire was presented to some experts such as a university psychometrician and some teachers who had been teaching measurement and evaluation for their comments. Also, some students were asked to evaluate the questionnaire. Reliability test using Cronbach's alpha computation showed a result of 0.905. Students' responses to the MSLQ questionnaire were scored based on the manual designed by (Pintrich, et al., 1991).

Data Collection

Administration of Tests. The researcher administered the pretest for the teacher made test and MSLQ one week after the start of the class and at the end of the course.

Conducting Classes for the Study. The researcher taught the section under study for two reasons. First, training another teacher on the rationale and implementation of the various teaching strategies to be used in the study would take a considerable time. Second, correct implementation of the SRL model must be ensured. An observer was present as the researcher conduct the study. During the orientation period of two meetings, the students were informed that the course was to be conducted using self-regulated learning model of teaching. The following important things regarding the conduct of the class were discussed among the students during the orientation period: a) freedom throughout the course in showing understanding of the concepts as guided by the learning objectives for each lesson; b) importance of self-regulation strategies, such as analyzing the learning task, setting of learning goals, choosing appropriate strategies to master material and to show their understanding of the concepts, and monitoring their performance; c) keeping of outputs inside envelope to help them monitor their class performance; d) use of rubrics in rating learning outputs; e) making of reflective journal in a notebook; and f) working in a group randomly chosen by the teacher

In the entire duration of the study, the students were given autonomy to choose their strategy on how they were going to present their understanding of the concepts of the specific lesson. They were given the objectives for the next lesson as their guide and were also instructed to read always the course reader in advance. During class activity, students worked in groups of five or more with members randomly selected by the researcher. Teacher-made grouping is said to result in higher student achievement than self-selected grouping (Baer, 2003).

In addition, student outputs, either a performance or a product, were rated using rubrics. Each group rated the learning outputs presented by the different groups except their own group. The results of the rating and feedback on the learning outputs were given to the groups in the next meeting. To encourage teamwork to work cooperatively in making the learning outputs, the researcher informed the students that they were given only one rating for all the members of each group on their learning outputs. In cases a representative of a group presented their output, the same score or rating was given for all the members of the group. Sharing of ideas and answers

was emphasized. A collaborative rubric was also given to rate the performance of the group members.

After all presentations were made, the researcher and some students, gave oral short feedbacks to the different group outputs. Then, evaluation in the form of quiz was administered. Finally, objectives for the next lesson were presented before the class ended to help students prepare for the next lesson activity.

Subject Matter Content. The topics included for the study were Introduction to Biology, Chemical and Cellular Bases of Life, Taxonomy and Plants, and Human Body Systems. Lesson sequence was based on the course syllabus.

Statistical Analysis. Descriptive analysis was aided using frequency and mean. For inferential analyses, t-test for dependent (paired) samples was used to determine if there were significant differences in the mean pretest and posttest scores. Pearson's Product Moment Correlation Analysis (Pearson's r) was also used to determine the correlation of MSLQ results to students' achievement. The significance for all inferential statistics was set at alpha 0.05. All statistical computations were done using a statistical software.

Results and Discussion
Mean Pretest, Mean Posttest, and Mean Gain Scores

Table 1 reveals an increase of mean scores. There is an increase in the posttest score with mean gain score of 13.44. The result may suggest that SRL method increased the students' level of knowledge and, in turn, students' achievement in Biological science.

Table 1. *Pretest, Posttest, Mean Gain Scores*

Variable	Mean	S.D.
Pretest Score	31.54	5.23
Posttest Score	44.97	8.66
Mean Gain Score	13.44	7.08

Mean Difference between the Mean Pretest and Posttest Scores

Comparing the mean scores of pretest and posttest in Biological Science paired sample t-test revealed p-value less than 0.05 (Table 2). This indicates that there was significant difference between the mean pretest and posttest scores in Biological Science test. SRL method significantly increased students' achievement in Biological Science.

Table 2. *Paired Samples t-test on the Mean Pretest and Posttest Scores*

t-value	df	p-value
11.849*	38	<0.001

*Significance at p < 0.05

Motivated Strategies towards Science Learning Questionnaire (MSLQ) Results

Table 3 reflects the total mean MSLQ scores of students. Results show that the total mean scores of both Motivation and Learning Strategy scales increased. Posttest mean scores were higher than that of the pretest. The results suggest that students exposed to SRL method increased their motivation and use of different learning strategies as they went through the learning process in the entire duration of the study.

Comparing the two scales, the mean scores of Learning Strategy scale were higher than of the Motivation scale. The results may suggest that students exposed to the SRL method were motivated and made use of more learning strategies as they went through the learning process. They were exposed to conditions that provided greater opportunity for them to experience activities that developed them to become more self-regulating learners. This follows what Krutman and Gutman (2006) indicated that SRL is teachable. Teachers can create conditions and teach ways to help students become self-regulating learners. They just need to provide a very good support in helping students identify effective ways to reflect and regulate their ideas.

Table 3 also shows that Motivation and Learning Strategy scale scores were greater than 5. These reported mean scores were nearer the highest scale score 7, which corresponds to "very true to me".

When the specific subscales for the Motivation and Learning Strategies scales were examined, there were changes observed in the pretest and posttest. Among the Motivation subscales it is only Self-Efficacy that decreased in mean score. This is in contrast to what Cobb (2003) mentioned, that the use of self-regulated learning strategy increases self-efficacy. Nevertheless, the decrease in Self-efficacy mean did not affect the students' achievement as evidences in the increase in the mean posttest scores.

In addition, Task Value Score has the highest mean posttest score while Test Anxiety has the lowest. This increase in the mean Posttest score of Task Value Score indicates that the students increased their interest and perceived utility of the subject matter as they went through the learning process using SRL method. It also indicates that the increased interest and perceived utility of the subject matter are the same factors that greatly motivated the students to learn following SRL method.

On the other hand, despite of having the lowest mean score, there was an increase in Test Anxiety mean score). Again, this result contradicts to what Cobb (2003) mentioned, that the use of regulated learning strategy decreases anxiety. However, despite this increase, they were able to improve their achievement in Biological Science.

In addition, there were also increase in the means of Intrinsic Goal Orientation, Extrinsic Goal Orientation, Control of Learning Belief, and Test Anxiety. The increases in both intrinsic goal orientation and extrinsic goal orientation would suggest that the students exposed to SRL method increased their motivations for various intrinsic and extrinsic reasons.

For the Learning Strategy subscales, it is noted that Elaboration subscale yielded the highest mean posttest score while Help Seeking has the lowest mean posttest score. In addition, only Effort Regulation subscale has a decreased mean posttest score. This decrease would suggest that students decreased regulating their effort towards their performance of learning tasks as they became used to the strategy. Despite this, however, the students increased their achievement.

Although Help Seeking has the lowest mean posttest score, which may indicate that it is the least used learning method by the students, there was an increase in the mean posttest score. This suggests that the students in the entire duration of the study asked support from teacher and peers in their performance of learning tasks. This is supported by the increase in the mean score of Peer Learning subscale. This result further indicates the increased reliance of students for support from peers in the performance of learning tasks, since in the entire duration of the study under SRL method, they were usually paired or grouped to work on learning tasks and achieve learning objectives.

In addition, Rehearsal, Organization, Critical Thinking, Metacognitive Self-Regulation, and Time and Study Environment subscales have noted increased in their mean posttest mean scores. The increase in the mentioned learning strategies subscales would indicate that students: increased their use of reciting or naming to memorize concepts; increased organizing their notes; became more aware of their own thinking processes and were able to relate and saw the application of the knowledge that they learned to new situations; managed their study time better; and organized their study environment much better. All of these may all have contributed to improve achievement in Biological Science of students in the control group.

The reported mean scores of Learning Strategy subscales in both groups were also nearer the highest scale score 7, which corresponds to "very true to me".

Table 3. *Mean MSLQ Scores of Students*

Scales	Prestest Mean	S.D.	Post test Mean	S.D.
Motivation Scale	32.75	8.66	33.32	3.61
	5.46	0.56	5.55	0.6
Intrinsic Goal Orientation	5.75	0.79	6.02	0.76
Extrinsic Goal Orientation	5.21	1.29	5.27	1.18
Task Value	6.26	0.68	6.38	0.78
Control of Learning Belief	6.29	0.89	6.3	0.72
Self-Efficacy for Learning	5.28	0.87	5.11	1.15
Test Anxiety	3.96	1.38	4.24	1.33
Learning Strategy Scale	46.43	5.68	47.22	6.72
	5.12	0.63	5.25	0.75
Rehearsal	5.37	1.11	5.46	0.9
Elaboration	5.72	0.87	5.85	0.98
Organization	5.4	1.25	5.42	1.41
Critical Thinking	5.45	0.8	5.73	1.23
Metacognitive Self-Regulation	5.28	0.67	5.36	0.88
Time & Study Environment Mgt	5.05	0.84	5.07	0.92
Effort Regulation	4.85	0.84	4.69	0.8
Peer Learning	4.64	1.15	4.89	1.34
Help Seeking	4.67	0.95	4.77	0.94

Mean Differences in MSLQ Result

Comparing the mean scores of pretest and posttest in both Motivation and Learning Strategy Scales paired sample t-test revealed p-value greater than 0.05 (Table 4). This indicates that there were no significant differences between the mean pretest and posttest MSLQ scores in both scales before and after the intervention. This may suggest that SRL method has sustained students' adaptive motivation and self-regulatory learning strategies in the entire duration of the study.

Table 4. *Paired-sample t-test on the Mean MSLQ Scores*

MSLQ Scale	t-value (df=38)	p-value
Motivation	0.995	0.326
Intrinsic Goal Orientation	1.94*	0.06
Extrinsic Goal Orientation	0.354	0.725
Task Value	1.029	0.31
Control of Learning Belief	0.024	0.981
Self-Efficacy for Learning	1.21	0.233
Test Anxiety	1.04	0.306
Learning Strategy	0.841	0.406
Rehearsal	0.519	0.607
Elaboration	0.792	0.433
Organization	0.097	0.923
Critical Thinking	1.498	0.142
Metacognitive Self-Regulation	0.792	0.433
Time & Study Environment Mgt	0.126	0.901
Effort Regulation	0.986	0.331
Peer Learning	1.038	0.306
Help Seeking	0.549	0.586

*Significance at p < 0.05

Correlation of MLSQ and Students' Achievement

Test on correlation of MLSQ and students' achievement in Biological Science showed positive correlation (Table 5). The computed significant values or both Motivation and Learning Strategy scales were higher than 0.05. There is no significant relationship between MLSQ results and students' achievement in the

When all the MSLQ subscales were examined, there are subscales that yielded significant values lesser than 0.05. These include: Test Anxiety and Time and Study Environment Management. This indicates that the mentioned subscales had significant relationships to the achievement among the students exposed to SRL method. Test Anxiety has negative correlation,

while Time and Study Environment Management has positive correlation; however, both subscales showed moderate relationship with students' achievement score.

The reported significant negative relationship of Test Anxiety to students' achievement corroborates the report by Pintrich et al. (1991), that test anxiety has been found to be negatively related to academic performance.

The significant moderate positive correlation of Time & Study Environment Management and students' achievement score may imply that students' management of time and study environment activities had positive relationship to students' s achievement score. In SRL method the students had to think of various strategies to show their understanding of the Biological Science concepts, they had to effectively manage their time and study environment in order to meet the objectives of the lessons and to perform better. Although it is a moderate relationship, it may have contributed to the increase in the mean posttest scores among students exposed to SRL method.

This finding on Time & Study Environment Management corroborates to what Wolters (1999) reported that use of motivational strategies of self-regulated learning such as time and study environment management affected students' performance academically.

Table 5. *Pearson Correlations between MSLQ Scores and Achievement Scores of Students in the Control and Experimental Groups*

MSLQ Scales	r	Sig. (2-tailed)
Motivation	-0.24	0.15
Intrinsic Goal Orientation	-0.19	0.26
Extrinsic Goal Orientation	-0.01	0.94
Task Value	-0.05	0.75
Control of Learning Beliefs	0	0.99
Self-Efficacy for Learning and Performance	-0.13	0.45
Test Anxiety	-0.39	0.01[*]
Learning Strategy	-0.13	0.45
Rehearsal	-0.07	0.66
Elaboration	-0.27	0.1
Organization	-0.2	0.23
Critical Thinking	-0.25	0.12
Metacognitive Self-Regulation	-0.19	0.24
Time & Study Environment Mgt	0.46	0.00[*]
Effort Regulation	0.01	0.93
Peer Learning	-0.16	0.34
Help Seeking	0.02	0.89

*Significance at $p < 0.05$

Conclusion

SRL method significantly increased students' level of knowledge and, in turn, students' achievement in Biological Science. The active method also sustained students' use of self-regulated learning strategies and engaged the students in different factors that motivate them towards learning Biological Science in the entire duration of the study.

Recommendation

From the findings of the study, it is recommended that this research be replicated with a greater number of classes. This study used only one intact class. Increasing the number of classes may produce more conclusive findings. In addition, the study be conducted in comparison with other teaching methods to see its effectiveness when compared to other method in relation to teaching Biological Science. It is also recommended that teachers should not only use one teaching method for the entire term to prevent boredom or burn-out for both teacher and learners.

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