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The Convergence of Mastery Learning Approach and Self-Regulated Learning Strategy in Teaching Biology

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Abstract
This study investigated the convergence of Bloom's Mastery Learning Approach (MLA) and Bandura's Social Cognitive Theory in Zimmerman's Self-Regulated Learning (SRL) Strategy in increasing students' academic performance in Biology. Fifty-two students in Biological Science enrolled in the second semester, SY 2007 – 2008, were used as subjects of the study. The Quasi-Experimental Design was used in the study: a pre-test was conducted, scored and analyzed which served as the basis in determining the initial learning schema of the respondents. After the execution of the lessons using the converging models of MLA and SRL Strategy, the students were given a post-test. It was found out that the students who were exposed to the converging teaching modalities developed better performance in Biology. ANCOVA results on the post-test mean scores of the respondents were utilized in establishing the causal-effect of the converging models to the academic performance of the students in Biology. A highly significant effect on their academic performance and significant interaction of the models to the experimental grouping and mental abilities of the respondents are concluded in the study.
Keywords: Academic Performance, Bandura's Social Cognitive Theory, Mastery Learning Approach, Self-Regulated Learning, Students' Motivation in Science Learning

1. The Problem and Its Background

The incomparable achievement gaps among different groups of students had been an alarming concern in any educational instruction especially among subjects that are highly cognitive in nature. Over the years, teachers across all levels had just focused on what is new in education but never that they realized to reduce these disparities in the academic achievement of these student-learners (Guskey, 2005)

According to Bloom, in Gagne (1988), these incomparable disparities in the academic achievement of students were attributed to some variations that affect students' success in their courses of studies. Hence, they must be addressed properly through responsive teacher's instructional planning design and practices. The crux is: the teaching learning process must be based on the notion of managing learning rather than managing the student-learners if it is to be responsive. It must provide equal opportunities across different groups of students in a heterogeneous class.

College instruction is viewed mostly by most professors for content mastery and progressed through lecture-discussion as subjects are potpourri of concepts which are taken in a limited time. Hence, professors develop the course outline in a traditional point of view of teaching and learning. Consequently, student-learners are developed through bookish competencies anchored on low levels of learning. Therefore, their success is only limited to their capacity to memorize bits of information in a dogmatic standpoint.

From these perspectives, the researcher found it highly desirable to investigate on the variations that Bloom construed in his Mastery Learning Model in 1976 – to find an effective corrective instructional treatment on the educative processes responsive to the needs of a varied group of learners and integrate strategies that will make students learn how to learn and train them to become aware of their own learning (Tuana, et al, 2005). In the choice of strategy, teachers should not only focus on developing conceptual understanding among students, but also on developing skills for high order thinking in a self-regulated learning environment. Hence, converging the Bloom's Mastery Learning Approach (MLA) with Bandura's Social Cognitive Theory in Zimmerman's Model of Self-Regulated Learning (SRL) strategy.

Bloom's Mastery Learning Approach

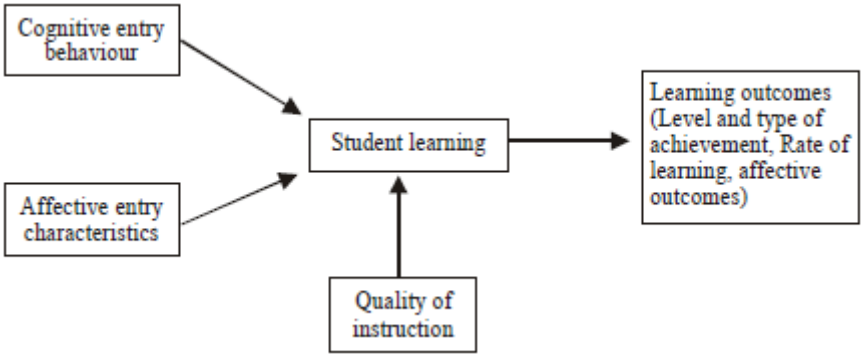

Figure 1. The Mastery Learning Approach Model (Bloom, in Gagne 1988)

Figure 1 presents the model of Bloom's Mastery Learning Approach. He theorized that Mastery Learning Approach (MLA) leads to the proper utilization of a systematic design of instructional programs in achieving instructional objectives. Instruction is moderated by the cognitive and affective entry characteristics of the student-learners. These characteristics serve as the bases for the adoption of transformative instruction from a virtually adventitious feature of programmed instruction to a major desirable characteristic of instruction in general (Gagne, 1988).

This approach uses a criterion-referenced instruction rather than norm through corrective feedback and reinforcement activities. Feedback and reinforcement loops, together with corrective instructions, are based on numerous small units of well-defined and sequenced course outline and outcomes. The teacher utilizes techniques of group dynamics and individualized instruction into corrective and constructive learning situations. It brings the learning strategies of successful students as live models of other students in understanding the learning tasks.

It starts with a needs' analysis that determines what needs to be taught well and learned by the student-learners. With a classified learning objective, proper technique as to which said objectives will be attained better into a valid and meaningful learning outcome. This calls for sound instructional tactics of the teacher that complements learning theories responsive to the cognitive and affective entry characteristics of student-learners. Hence, the teacher must model competencies on information-processing so as to transform temporal duration tactics into receptions of information stimuli over executive control of the learners in processing their learning and memory towards an instructional objective.

Bandura's Triadic Social Cognitive Theory

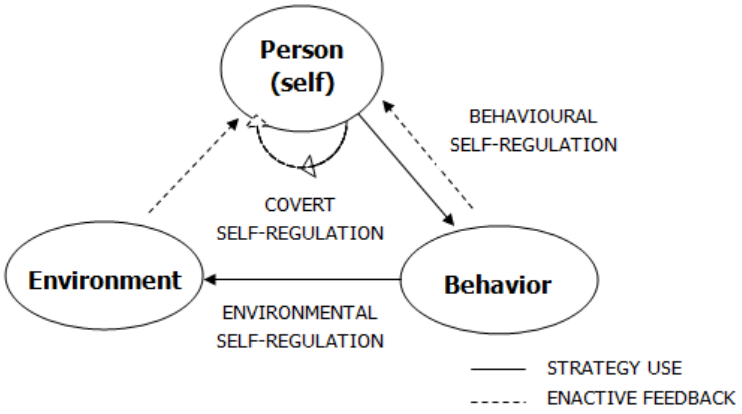

Figure 2. The Triadic Social Cognitive Theory (Bandura (1986) in Zimmerman, 1989)

Figure 2 presents Bandura's Triadic Social Cognitive Theory. It posits that Social Cognitive Theory advocates triadic reciprocal determinism of personal, behavioral, and environmental factors affecting functioning schema of each individual. Bandura emphasized that in reciprocal determinism, the behavior of student-learner is a product of the interaction of both personal and environmental factors. These three factors, also referred as

determinants, exert regulatory influence controlling covert (i.e. personal), behavior, and environment processes through direct strategy and enactive feedback..

Included in this theory are the three basic social learning concepts: (1) Observational Learning: learners learn and imitate behaviors that they have observed in other learners. He identified three basic models: (a) Live model that involves an actual individual demonstrating a behavior, (b) A verbal instructional model that involves descriptions and explanations, and (c) a symbolic model which involves a real or fictional character displayed by the material; (2) Intrinsic Motivation: This focuses on the internal thoughts and cognition developed by the learner that helps him connect learning theories and development theories. He included pride, satisfaction and sense of accomplishment as his internal drives to carry out cognitive tasks in learning; (3) The Modeling Process: He noted that not all observed behaviors are effectively learned as both the model and the learner play roles. The process includes attention, retention, reproduction and motivation. As attention plays a major role in social cognition, every aspect of learning environment must be interesting for learners dedicate their full attention to learning when they got interested in it. This also poses motivation and retention of information which are vital in observational learning.

Zimmerman's Model of Self-Regulated Learning

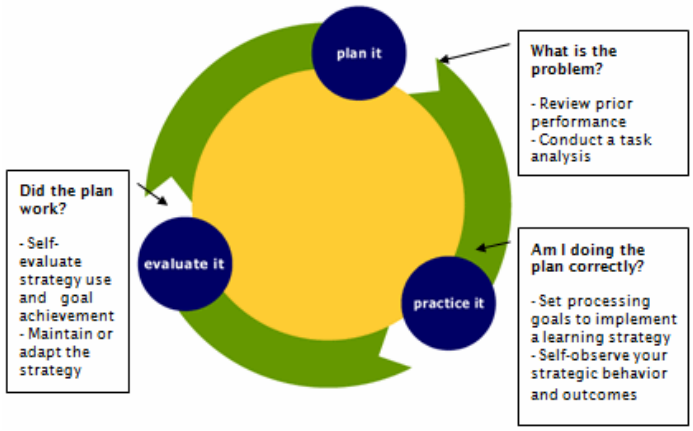

Figure 3. Zimmerman's model of Self-Regulated Learning (Zimmerman, 2001)

Figure 3 presents Zimmerman's Model of Self-Regulated Learning Strategy. The model is observed in a cyclical nature that involves planning, practice and evaluation. Multiple opportunities abound the student-learners to gather and effectively use learning feedbacks to improve his performance. During the *planning phase*, students learn to accurately assess their academic situation and choose strategies that best address a specific learning challenge. They also set achievable short- and long-term goals by recalling and analyzing his previous learning schema and performances. This develops an inner drive that motivates him to do his learning tasks better. During the *practice phase*, learners implement the selected strategies and make on-going adjustments to their plan as they self-monitor their progress. Lastly, during the *evaluation phase*, student-learners assess the applicability and correctness of each strategy in helping him achieve his goals. Constructive feedback is drawn in the evaluation phase. This generates a better plan in the next SRL cycle.

1.1 Objectives of the Study

This study was designed to discern the effects of the convergence of the mastery learning approach (MLA) and self-regulated learning (SRL) in select topics in Biology with techniques and strategies offered in a constructive learning environment.

Specifically, it sought to find the explanations of the following:

1. How do the respondents assess their motivation in learning Biological Science?
2. What are the mean pre-test and post-test scores of students exposed to the converging models of Mastery Learning Approach (MLA) and Self-Regulated Learning (SRL) and traditional method?
3. Are there significant differences between the pre-test and post-test scores of students exposed to the converging models of Mastery Learning Approach (MLA) and Self-Regulated Learning (SRL) and traditional method?
4. Is there a significant relationship between the students' motivation in learning science and their academic achievement in Biology?

1.2 Research Paradigm

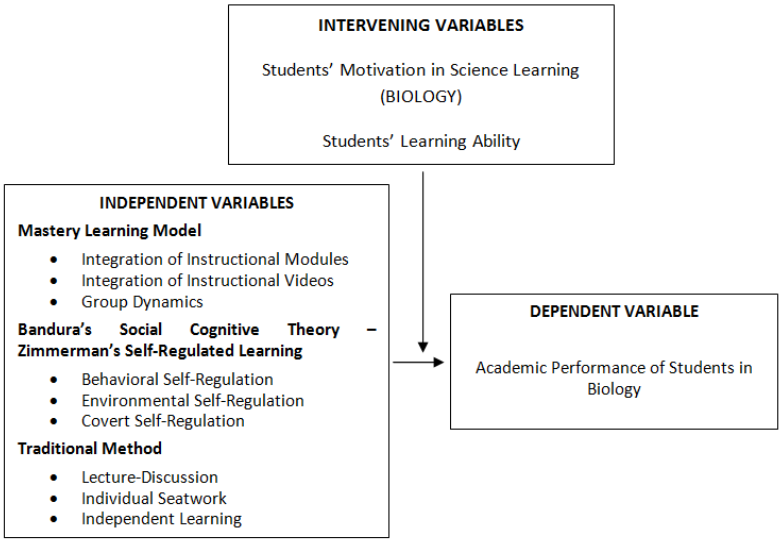

Figure 4. The Research Paradigm

Figure 4 presents the paradigm of the study. This study made use of the Bloom's Mastery Learning Approach (MLA) in concealing learning disparities of the different groups of students in a learning environment. It introduced instructional modules and group dynamics in segmented learning videos of mitotic and meiotic cell division. The learning environment was guided through the tenets of Bandura's Social Cognitive Theory in Zimmerman's Model of Self-Regulated Learning. On the other hand, the control group received the traditional methods of college instruction.

This manipulation and contraventions on the learning experiences of the students are believed to reshape their motivation and academic achievement towards Biological Science as it had been mystified as difficult since time immemorial. The students' motivation in science learning (Biology) is believed as a potential variable in the success of the students in the subject.

2. Research Methodology

The Quasi-Experimental Design (pretest-posttest control group design) was used in this study. This provided bases for the causal effect of the independent variable to the dependent variable involving experimental and control groups. Treatment (integration of eclectic methodologies and approaches on the convergence of the mastery learning approach (MLA) and self-regulated learning (SRL) in teaching Biology) was introduced in the experimental group. The discourse treatment, which includes instructional modules and segments of instructional videos, was limited only in the development of Mitotic and Meiotic Cell Division. Modeling of the eclectic methods and approaches was integrated in the discourse treatment as well as reinforcement strategies based on Bandura's Social Cognitive Theory in Zimmerman's Model of Self-Regulated Learning strategy. The use of groupings and motivation was introduced in the process. Analysis of the scores was done to conclude on the causal effect of the independent variables.

On the other hand, the customary instruction was made to the control group with the usual class session, ordinary assignment, individual seatwork and exercises.

This study was conducted at the General Education Courses of Cagayan Valley Computer and Information Technology College, Philippines, during the second semester of SY 2007 – 2008. Two sections of fifty-two students handled by the researcher in Biological Science were utilized in the study. Lottery was done in determining the experimental grouping of the study.

This study made use of an adopted questionnaire on students' Motivation towards Science Learning (Tuana, H.L., Chin, C.C., and Shieh, S.H., 2005) in determining the motivation level of the respondents in learning Biology and a Teacher Made Test developed by the researcher to determine their academic achievement in Mitotic and Meiotic Cell Division. A two-way Table of Specification was used to determine the content validity of the instrument. The result of the pre-test conducted was used in determining the learning ability of the students in Biology as it is their initial course in Biological Science in their course of study.

The Mean, Percentage, Independent t-test, ANCOVA, and Pearson-r correlation were used in the treatment of the data gathered to conclude on the stated research problems.

3. Results and Discussion

Table 1. The Students' Motivation in Learning Science (Biology)

	Indicators	Respondents		Composite	
		Experimental	Control	Mean	Descriptive Interpretation
1	Self-efficacy	4.41	4.04	4.23	Agree
2	Active learning Strategy	4.55	4.27	4.41	Agree
3	Science Learning value	4.47	4.18	4.33	Agree
4	Performance Goal	4.43	4.00	4.22	Agree
5	Achievement Goal	4.66	4.10	4.38	Agree
6	Learning Environment Stimulation	4.76	4.66	4.71	Strongly Agree
	Average	4.55	4.21	4.38	Agree

Table 1 presents the students' motivation in learning science particularly in Biology. It presents that the respondents totally agree that they manifest a positive motivation in learning the subject as indicated by their composite mean score to the indicators set forth in this study: 4.23, 4.41, 4.33, 4.22, 4.38, and 4.71 for self-efficacy, active learning strategy, science learning value, performance goal, achievement goal and learning environment stimulation, respectively. Great emphasis is given on the motivation of the students in learning environment stimulation as the respondents vouched a strong positive motivation (mean of 4.71).

It can be construed that a constructive learning environment is a potent factor in any educative process. Learners tend to be active and responsive to the dynamism of the classroom routine if they take part in the process. This confirms the conclusions of the studies of Abbott and Fouts (2003), Kim (2005) and Bautista (2004) in personalizing the classroom routines through self-paced instructions. They concluded that students learn best when students are involved in the discussion and other challenging classroom cognition.

Table 2. Test of Difference on the Pre-test and Post-test Mean Scores of the Respondents

	Respondents	N	Mean	t	df	Sig. (2-tailed)
Pre-test	Experimental Group	27	7.85	-.408	46.962	.685
	Control Group	25	8.32			
Post-test	Experimental Group	27	15.48	4.760	49.806	.000*
	Control Group	25	10.88			

Presented in the table is the mean of the pre-test and post-test scores of the students on the achievement test conducted at the end of the treatment phase of the study. It shows that the control group had a better learning schema on the subject: mean of 8.32 versus 7.85 of the experimental group. However, the experimental group developed better achievement mean score after the treatment: 13.41 over 10.88 of the control group.

It also presents the test of difference on the pre-test and post-test mean scores of the respondents. It presents that there is no significant difference on the mean pre-test scores of the respondents with a t-value of -0.408 and p-value of .685 at 0.05 level of significance. Hence, the null hypothesis of no significant difference on their prior learning schema in the subject is accepted. However, it can also be gleaned that there is a highly significant difference on the mean scores of the respondents in the post-test conducted: t-value of 4.760 and p-value of <.001 at 0.05 level of significance. This lead to rejecting the null hypothesis of no significant difference on the mean scores of the students in the post-test after the treatment was done.

Table 3. The Two-way Analysis of Covariance on the Tests Conducted

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	440.680[a]	4	110.170	11.727	.000*
Experimental Grouping	199.649	1	199.649	21.251	.000*
erimental Grouping * Learning Abilities	43.614	1	43.614	4.642	.036*

a. R Squared = .524 (Adjusted R Squared = .484)

*. Significant at the 0.05 level (2-tailed).

Presented in table 3 is the two-way analysis of covariance of the tests conducted between the two groups of the study. It presents the causal effect of the teaching model to the academic achievement of the students when grouped according to their experimental grouping and the interaction of the experimental grouping with the respondents learning abilities: F-values of 21.251 and 4.642, and p-values of <.001 and .036, respectively. This means that the students under the experimental group who experienced the converging models of Bloom's Mastery Learning Approach (MLA) and Bandura's Social Cognitive Theory on Zimmerman's Self-Regulated Learning (SRL) performed better in the subject after the method was introduced in their learning experiences and became a potent mechanism in their learning-routine.

It can be noted, however, that the impact of the models of reconstructing the instruction is moderately low considering that the coefficient of determination indicated by the adjusted R-squared is only .524. This means that the models of teaching account for 48.4 % of the variability in the academic achievement of the students. It is construed then that there are other important variables or factors such as student ability and other classroom techniques which may explain better the difference in the academic achievement of the groups of students in both the experimental and control groups.

Table 3 likewise presents the interaction between the students' motivation in learning science and the method (treatment conditions of the converging Bloom's Mastery Learning Approach (MLA) and Bandura's Social Cognitive Theory on Zimmerman's Self-Regulated Learning (SRL). It presents the impact of the treatment conditions to the academic achievement of the students across the learning abilities of the students in the two groups as shown in Figure 5.

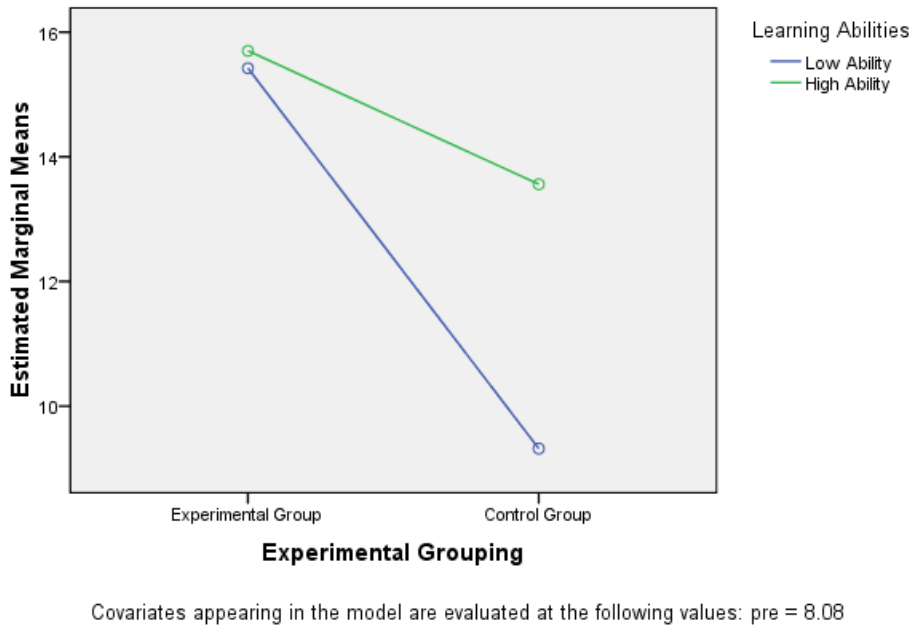

Figure 5. Estimated Marginal Mean of the Post-test Scores

Figure 5 presents the relationship of the estimated marginal means of the post-test result and the learning abilities of the students, categorized as low and high. The result of the post-test mean score is evaluated with the pre-test covariate value of 8.08. It presents that the lowly able students in the experimental group benefited the most in the program. It can be concluded then that the teaching modality provides better experiences that made them perform better in the subject. Hence, provided a comparable academic performance in the subject.

In general, the results of the study indicate that students who were exposed to the constructive instruction obtained a significantly higher mean post-test score on their academic achievement than the students who were exposed to the customary teaching models and techniques. This result affirms the theory of Bloom's on Mastery Learning which posits that the approach conceals the disparities of the incomparable academic performance and achievement of students across their learning abilities. It likewise affirm Bandura and Zimmerman's Self-Regulated Learning strategy as it conjectures that student-learners gather and effectively use corrective learning feedbacks to improve his performance in a varied and challenging environment. Hence, the Bloom's Mastery Learning Approach (MLA) becomes more effective when it converges with Bandura and Zimmerman's Self-regulated Learning strategy (SRL) as it improves better the students' academic achievement, self-concept, and learning strategies.

The result also conforms to the findings of Martinez & Martinez (2001), Lawrence (2003), Guskey (2005), Kazu (2005) and Wambagu & Changeiywo (2006) when they concluded that Mastery Learning Approach and Self-Regulated Learning Strategy increase students academic performance and achievement across their learning abilities towards the subject.

Table 4. The Relationship between the Students' Motivation in Learning Science and their Academic Performance in Biology

		Students' Motivation in Learning Science					
		SE	ALS	SLV	PG	AG	LES
Post-test	Pearson Correlation	.565**	.382**	.302*	.444**	.475**	.557**
	Sig. (2-tailed)	.000	.005	.030	.001	.000	.000
	N	52	52	52	52	52	52

Legend: SE – Self-Efficacy; ALS – Active Learning Strategy; SLV – Science Learning Value;
PG - Performance Goal; AG – Achievement Goal ; LES – Learning Environment Stimulation

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 presents the correlation analysis of the students' academic achievement and their motivation in learning science. A highly significant correlation is observed in self-efficacy, active learning strategy, performance goal, achievement goal, and learning environment stimulation: p-values of <.001, .005, .001, <.001 and <.001, respectively at 0.01 level of significance, and a significant relationship is observed between their academic achievement and science learning value with a p-value of .030 at 0.05 level of significance. This means that the greater the motivation drive that students develop, the faster they respond to learning tasks in the dynamic classroom environment.

It can be construed that motivation emanates from the drive of the student-learner developed within him. This phenomenon can be explained by the Attitude-Behavior Consistency Theory of Kallgren and Wood (1986) and the Cognitive Evaluation Theory of Deci and Ryan (1991). Kallgren and Wood theorized that attitude (predispositions to behavior) and actual behaviors are more likely to align when both attitude and behavior are both constrained to circumstances that happened in the past. Attitudes, that drives motivation, is held strongly around core beliefs. On the other hand, Deci and Ryan theorized that motivation given to a student-learner must fall within his current level of competency. This motivation is used by the learner in his evaluation of the applicability and correctness of his strategy in helping him achieve his goals. Constructive feedback is drawn and used in the next cycle. This generates a better plan in the next SRL cycle.

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