The Impact of Motivation and Learning Strategies as Predictors of Biology Performance among Non- Science Majors

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ABSTRACT

Science Education has improved the quality of life, developed competitiveness, and helped understand global issues. Thus, the present study identified the impact of motivation and learning strategies in Biology among non- science majors. The respondents chosen through simple random sampling for this study were the 83 Information Technology students taking Biology. The study used the descriptive method of research using Biology Motivation Questionnaire (Glynn and Koballa, 2005) and Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991). These instruments were administered thrice: at the start of classes, and a week before the midterm and the final examinations. The data gathered were tabulated and analyzed. The student's midterm exam scores in biology were used as measures of achievement. The statistical tools employed were mean, standard deviation, ANOVA and regression analysis. Results showed that non- Science majors have high motivation level. Among the sub- components: intrinsic, and extrinsic motivation, personal relevance and self- determination have very high contribution to the level of motivation especially to the high performers. The results further revealed that all the respondents have the low assessment anxiety in Biology. For the learning strategies used, high performers often used organization, metacognitive self-regulation skills, rehearsal and elaboration while low performers seldom used the given strategies. Average performers often used these strategies including critical thinking. The level of motivation is significantly different among the different course performers. Among the learning strategies, there is a significant difference in the use of organization, metacognitive self- regulation skills and rehearsal. Furthermore, the extrinsic and intrinsic motivation, personal relevance and self-determination are

significant predictors of better performance in Biology. In conclusion, the level of motivation and learning strategies used can predict the level of Biology performance of non- science majors.

Introduction

Science is a way of knowing and understanding through the exercise of reason and a construction of the mind based on actual observation to explain natural phenomena. The way science is taught, both at the high school and college level plays a major role in shaping students' attitudes toward science. However, despite the fact that science informs our thoughts and behaviors, many people do not seem to place a high value on science (Movahedzadeh, 2011). Studies report that the general public does not generally have positive feelings toward science and scientists.

One of the science subjects commonly taken by non- Science majors is Biology. Since this subject is labeled as general education, at times these non-science majors do not show much interest on the said subject. Studies show that students often think of science subjects as boring, abstract, and irrelevant, which they usually take because it is mandated by the curriculum. As such, science teachers are having a hard time motivating the students to learn science. Hence, one way of bridging discontinuities in science learning, is to identify students' level of motivation and learning strategy.

Motivation is a state that drives and sustains behaviors. According to Glynn (2006) as cited in Obrentz (2012), intrinsic and extrinsic motivation, task value, self-determination, self- efficacy and assessment anxiety are some of the important constructs for science learning. Motivation constructs answer questions why students are driven to learn. Apparently, learning strategies explain the specific action students take or perform to reach learning objectives. According to Miyaki, et al. (2010), these learning strategies are essential for science learning.

With these foregoing findings and information about learning science and how students should adapt to the importance of sciences, the researchers determined the impact of motivation and learning strategies on College Biology among non- science students.

Purposes of the Research

The main purpose of the study is to identify the impact of motivation and learning strategies in Biology of non-science majors.

1. What is the Biology motivation level of non-science majors as a whole and when classified into low, average and high performers?

2. What are the learning strategies used by non-science majors when classified into low, average, and high performers?

3. Is there a significant difference in the level of Biology motivation among the different performers?

4. Is there a significant difference in the learning strategies used by the different performers?

5. Which subcomponents of motivation and learning strategies used have significant predictive ability in Biology performance of non-science majors?

Literature Review

Motivation as defined is a process of initiating and sustaining a behavior that is goal-directed. There were certain views about motivation that contributed to its understanding. These views were the

drive theory, conditioning theory, cognitive consistency theory, and humanistic theory. For present theories, motivation is perceived as the one that reflects cognitive processes, even if these theories impose differences in the necessity attributed to several thoughts. Current theories view motivation as reflecting cognitive processes, although these theories differ in the importance ascribed to various cognitions. Models to motivated learning assume that motivation operates before, during, and after learning.

There are certain factors which are relevant to motivation-several researches and theories about self- concept. Research suggests that self-concept develops from specific one to a general self-view since it is hierarchically organized and multifaceted. Self- concept and learning, appear to impact each one in an alternate fashion (Schunk, 2012).

Achievement, motivation, attributions, and goal orientations have important educational applications. Achievement motivation programs are designed to foster students' desire to learn and perform well at achievement tasks. Attributional change programs attempt to alter students' dysfunctional attributions for failure, such as from low ability to insufficient effort. Attributional feedback for prior successes improves self-efficacy, motivation, and skill acquisition. Teachers can foster productive goal orientation in students by teaching them to set learning goals and providing feedback on their goal progress (Schunk, 2012).

Additionally it was known that motivation is one of the states that drives and sustains behaviors. In order for students to be motivated to learn in any discipline, they must participate in activities that are personally meaningful and worthwhile (Glynn & Koballa, 2006). By middle school, students' motivation to learn science is one of the most important predictors of science course success (Britner & Pajares, 2006). In a study with 8th graders, motivation strongly influenced science achievement (Singh et al., 2002). This trend continues in college. Most students reported that they were motivated to study science not only because they thought it would be helpful for a career, but also because they found it relevant to their health, life, and understanding of the world.

Motivation answers many questions about why students are driven to learn, but it does not always explain the specific actions students take or perform to reach learning objectives. Understanding which learning strategies relate to academic success can add to the discussion on predictors of science achievement in college. Unlike motivation constructs that at times seem innate and unchangeable, learning strategies may be changed based on environment, task, or demands. Learning strategies can also be taught in conjunction with course content (Bleicher et al., 2002), thus providing interventions that would support academic success in specific classes.

Learning strategies are essential for science learning because they assist students in mastering the foundational knowledge necessary for advancing within the discipline (Miyake et al., 2010). In science courses, students must retain basic information in order to learn new and advanced material (Bleicher et al., 2002). Students are expected to understand concepts and to apply content to problem-solving and scientific inquiry (Taasoobshirazi & Glynn, 2009). Using strategies that develop and encourage scientific ability help students in their college science courses and prepare them to solve real-life problems and tasks (Bao et al., 2009).

Framework of the Study

This study is anchored on the Expectancy-Value Theory of Achievement Motivation. This theory, emphasizes that behavior depends on one's expectancy of attaining a particular outcome (e.g., goal, reinforcer) as a result of performing given behaviors and how much one values that

outcome. Moreover, this theory believes that people judge the likelihood of attaining various outcomes. Thus, they are not motivated to attempt the impossible, so they do not pursue outcomes perceived as unattainable.

The present study is related to the aforementioned theory since, this also determined the impact of motivation, specifically, how non-science majors perform science activities when well- motivated. This study also looked into the aspect of learning strategies as predictors of biology performance.

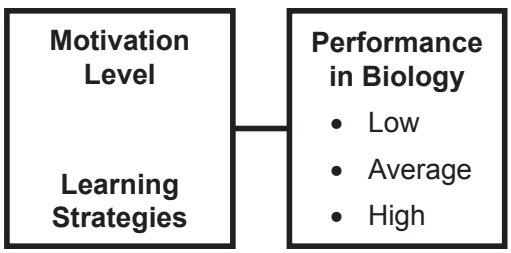

Figure 1. Framework of the Study.

Figure 1 shows the dependent variables which are the motivation level and learning strategies and the independent variables which are the performance in biology as classified into low, average and high performers.

Method

Research Design

The study used the descriptive method of research. Fraenkel and Wallen (2012) explained that descriptive research is a research to describe existing conditions without analyzing relationships among variables.

Participants and Sampling Method

The respondents of this study included 83 first Year BS Information Technology students enrolled in Biology subject, second semester, 2014- 2015. The sampling method used in choosing the participants was simple random sampling.

Instruments

The instruments used for data collection were Biology Motivation Questionnaire (BMQ) by Glynn and Koballa (2005) and Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich et al. (1991).

Data Collection

The procedures for the data gathering were the following: 1) The respondents were given instruments; 2) These instruments were administered thrice; at the start of the class and weeks before the midterm and final examination; 3) The data were gathered after the conduct of the instruments; 4) The data gathered were tabulated and analyzed; and 5) Student's examination scores in biology were used as measures of achievement.

Data Analysis

For descriptive data analysis, the tools used were mean, standard deviation and Pearson product moment correlation coefficient. z-test, Analysis of Variance (ANOVA) and regression analysis were used for inferential analysis.

Results and Discussion

The following tables show the mean motivation scores and performance level of the non-science majors who were taken as respondents for the study.

Table 1 presents the summary of the means, the standard deviations of motivation scores and the significance of the differences in motivation scores between groups of performers. In the given table, the over- all motivation and subcomponent scores were analyzed separately.

As presented in Table 1, the results showed that biology motivation level of non-science majors was high with intrinsic motivation having a very high contribution.

Table 1

Mean Motivation Scores

Variable	Mean	sd	Description
As a Whole	107.0	13.4	Highly Motivated
Sub Component			
Intrinsic Motivation	19.7	3.3	Very High
Personal Relevance	18.8	2.9	High
Extrinsic Motivation	19.0	3.0	High
Assessment Anxiety	14.4	2.4	High
Self Determination	18.0	2.6	High
Self-Efficacy	17.1	3.8	High

As for motivation and performance level, Table 2 results showed that mean motivation scores for column "average" was significantly different with that of low and high performers, although all scores within the range of high motivation level. The higher motivation scores of average performers were affected by very high intrinsic and extrinsic motivation, personal relevance and self-determination, with the latter not significantly different with high performers.

For assessment anxiety, it was evident that there was no main effect for performance group.

These foregoing results as to motivation and performance level were also related to the idea of Shunck (2012) that motivation is conceptualized as a continuum: Intrinsic and extrinsic motivation anchors the ends and in the middle are behaviors that originally were extrinsically motivated but have become internalized. This intrinsic as well as extrinsic motivation orientation according to Eccles and Wigfield (2002), discusses how rewards affect the engagement of students with certain learning activities. Accordingly, extrinsic motivation emphasizes behaviors when the students finished the tasks for an external outcome (Walker et. al., 2006). Thus, extrinsic motivation involves engaging in an activity for the purpose of earning high grades, pleasing parents or praise from peers and teachers.

In education perspective, intrinsic motivation results to deeper processing, greater mastery and even a better implementation of learning strategies. Students who are motivated inside would usually persevere in more challenging tasks, show positive classroom behaviors

Table 2

Mean Motivation Scores and Performance Level

Motivation	Low (M=74.2) Mean	Sd	Average (M=82.9) Mean	Sd	High (M=87.5) Mean	Sd
As a Whole	104.7[a]	12.8	118.6[b]	11.6	113.0[a]	6.6
Sub Component						
Intrinsic Motivation	19.3[a]	3.0	22.5[b]	1.9	21.0[a]	3.0
Personal Relevance	18.4[a]	2.9	20.9[b]	2.4	20.3[a]	1.5
Extrinsic Motivation	18.5[a]	3.0	21.2[b]	2.7	21.0[a]	0.0
Assessment Anxiety	14.3	2.2	15.0	2.7	14.0	2.0
Self Determination	17.2[a]	2.7	19.6[b]	2.1	20.3[b]	1.2
Self-Efficacy	17.0	3.9	19.4	3.9	16.3	1.5

**Range of Scale: Sub Components 5-9 (very low); 10-15(low); 16-19 (high); 20-25(Very high); reversed for anxiety, higher score indicates lower assessment anxiety*

Note: Means with different subscripts are significant with one another @ alpha= 0.05 according to LSD test.

and perform better in academics (Walker, et. al, 2006).

As identified, the undifferentiated needs for competence lead to self-determination. Intrinsic motivation often leads to self-determination. Non-science majors may avoid science activities, however, they work on it to obtain high or at least passing grades. As the skills developed, the student feels competent and perceives self-control and self-determination over learning.

The next tables (Tables 3 and 4) discuss the results of the learning strategies and performance level. Table 3 summarizes the means and standard deviations of the scores learning strategies as well as significant differences between groups of performers. The average performers had a significantly higher organization, metacognitive self-regulation and rehearsal scores than high performers although these learning strategies were often used by both performers. The low performers had significantly lower scores in the above mentioned learning strategies compared to both average and high performers and these were seldom used; however, these scores were not significantly different with the high performers. For critical thinking and evaluation, there were no significant main effects for achievement found.

Table 3.

Mean Learning Strategies Scores and Performance level

Learning Strategy	Low (M=74.2) Mean	Sd	Average (M=82.9) Mean	Sd	High (M=87.5) Mean	Sd
Organization	3.3[a]	0.7	3.9[b]	0.6	3.6[a]	0.8
Metacognitive						
Self-Regulation	3.3[a]	0.4	3.7[b]	0.3	3.4[a]	0.3
Critical Thinking	3.3[a]	0.6	3.6	0.6	3.3	0.1
Rehearsal	3.3[a]	0.5	4.0[b]	0.5	3.7[a]	0.5
Elaboration	3.5	0.6	3.8	0.7	3.7	0.3

Note: Means with different subscripts are significant with one another @ alpha= 0.05 according to LSD test.

Table 4 presents the motivation scales and learning strategies' ability to predict performance in biology for non-science majors using regression analysis. For motivational scale in totality, this indicated moderate positive correlation, contributing 15% of the variance in biology performance. Among the sub components, the intrinsic and extrinsic motivation, personal relevance and self-determination significantly indicated a generally positive relationship with the performance, but the relationship was far from being a perfect association. In particular, for many of the scores of motivation, it appeared that performance may be either low or high. But as these subcomponents increase, performance scores generally increased as well. These subcomponents of motivation significantly contributed 60% of the variance in biology performance of the non-science majors.

Table 4.

Regression Analysis for Motivation Scale and Learning Strategies

Motivation	r	r^2	p-value
As a whole	0.39	0.15	0.00
Sub Component			
Intrinsic Motivation	0.39	0.15	0.00
Personal Relevance	0.35	0.12	0.01
Extrinsic Motivation	0.38	0.14	0.01
Assessment Anxiety	0.07	0.00	0.65
Self Determination	0.43	0.19	0.00
Self-Efficacy	0.14	0.02	0.31
Learning Strategy			
Organization	0.30	0.09	0.03
Metacognitive Self-Regulation	0.31	0.10	0.03
Critical Thinking	0.18	0.03	0.22
Rehearsal	0.44	0.19	0.00
Elaboration	0.24	0.06	0.85

Among the learning strategies, rehearsal showed a significantly higher positive correlation though it might be interpreted as moderate, contributing 19% of the variance in biology performance.

Rehearsal was followed by metacognitive self-regulation and organization. These learning strategies contributed 38% of the variance in biology performance of non-science majors.

When dealing with science performance, Pintrich, et al. (1991) emphasized that science performance learning strategies can be classified as cognitive, metacognitive self- regulation, and resource management skills. In the aspect of cognitive skill, it included both surface and deep strategies. On surface strategies, one of the very common techniques used by students is rehearsal. Rehearsal is defined as process which involves repetition of information in order to recall and memorize facts. On the other hand, deep strategies commonly use elaboration which is known to be a process of making connections between new and previous learned information.

It was further emphasized that organization which is also one of the learning strategies is defined as summarizing of ideas and concepts which are related to each other by creating outlines, lists, concepts, and maps, while critical thinking is the applying of concepts to problem solving and other evaluations.

People believed that students can take several methods to learning. These methods are unstable traits in persons even if some students may take a deep approach and others will have the surface approach. Those students taking a deep approach intends to understand, engage with as well as value the subject (Lublin, 2003). These students try to learn for the purpose of repeating what they have learned, memorize information necessary for evaluation and make use of rote learning are motivated by failure. According to Schunck (2012), rehearsal may be the method chosen when one needs to memorize easy facts; but organization is more appropriate for understanding.

In view of performance level, Zusho et al., (2003) even fortified and further reported that high level performers use the method of rehearsal which has positively predicted introductory chemistry performance. On the other hand, Yu (1999) reported that using of these methods did not always foresee success college science courses.

These metacognition skills which are self- regulated include a different self-awareness activities in which the students monitor, evaluate and plan what they learn (Corno & Randi, 1999; as cited in Zimmerman, 2008).

Conclusion and Recommendations

Non-Science majors are highly motivated in performing and learning Biology. Hence, it is easier for the instructors to fully identify the learning strategies suitable for the students in order to encourage them to learn Biology.

The components which highly contribute to the respondents' motivation are intrinsic and extrinsic motivation, personal relevance and self-determination which significantly have a positive relationship contributing 60% of the variance in Biology performance of non-science majors. It implies that these students are internally inclined to learn Biology which is of big help for the instructors since a mere encouragement will motivate them to learn the subject.

Surface Cognitive Strategy provides more access to non- science majors to learn Biology. Thus, this may be employed as one of the learning strategies for future non- science major who will be taking Biology subjects.

Non- Science majors used cognitive learning strategies which are classified into surface such as rehearsal, deep strategies such as organization and metacognitive-self regulation. These are the predictors of performances in Biology of non- Science majors which could also be applied to other non- Science majors.

With the foregoing conclusions, it may recommended that future researches about motivation and learning strategies may be conducted to identify other non-Science major's motivation levels. For Science instructors and professors, they may also conduct future researches in line with interesting science activities that would tinker students' critical thinking skills like inquiry-based teaching strategies.

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