Test Anxiety and Moving Examination in Science Laboratory Classes

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This study determined if test anxiety and moving examination was associated with achievement, attitude, and skills in science laboratory classes. Using correlational research design, this study helped in assessing the process through which test anxiety and moving examination (the predictor variables) affected students' achievement, integrated process skills, and attitude towards science (the criterion variables). A total of 109 students participated in the study. Measures of Test Anxiety Questionnaire (Suinn, 1969), Science Moving Examination, Integrated Science Process Skills Test (Mungandi, 2005), and Attitude towards Science Inventory (Gogolin & Swartz, 1992) were used. Panel of experts' content validated the questionnaires used. Analysis of results indicated that increase of achievement in science, acquisition of integrated science process skills and development of positive attitude towards science were all nonsignificantly associated to test anxiety. Students' preparedness for the moving examination allowed them to combat their test anxiety; and thus, their achievement in science remained unaffected. Integrated science process skills, on the other hand, were already acquired by students prior to taking the moving examination, so test anxiety did not interfere in the acquisition of said skills. Attitude towards science was also not affected by test anxiety because the preference towards science was unpredicted by a definitive stimulus.

Keywords. Test anxiety, moving examination, achievement in science, integrated science process skills, attitude towards science

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Recent studies suggest that Filipino students' mastery level in mathematics and science are weak when they graduate from high school (Espinosa, Monterola, & Punzalan, 2013). In case of a private collegiate institution in Manila, tertiary level science teachers observed that students often get a low grade or a failing grade in any 3-unit, 4-unit, or 5-unit science subject. Conclusively, a general trend of underachievement in science is also present in the collegiate level. Informal interviews conducted with students revealed that science courses are often perceived as very difficult compared to their professional courses; hence, they find it uninteresting. In addition, students attributed their perceived difficulty in science to course information overload. Apparently, presence of test anxiety follows; thereby, affecting their preparation for examination and performance in the examination itself. As a result, their obtained score in the examinations often fall short of the average which may lead to underachievement in the course.

Test Anxiety

Test and examinations are assessment techniques used in education to evaluate the transfer of learning. Apparently, results reflect their performance that includes their abilities and skills. Ohman (2000) connoted that anxiety comes from unknown threats which renders hesitation, uneasiness, and tension. This unknown threat is normally viewed as an unlikely event that stimulates futuristic thinking, thereby, increases one's preparedness to cope with it (Barlow, 2002). When their test scores becomes the basis of important decisions and consequences, students are more inclined to experience some level of anxiety (Urbina, 2004). Numerous researchers (Basak & Yesilel, 2012; Michele, 2006) connoted the term test anxiety as a situation-specific personality trait composed of physiological worry and fear experienced during testing situations that generally interferes with normal learning and test performance. Udeani (2012) explained that test anxiety arises from academic or intellectual evaluative situation causing intense anxiety leading to difficulty in adequately studying for and performing on their examinations.

Inverse relationship between the levels of test anxiety and academic achievement outcome has been demonstrated in numerous researches. Students having high levels of anxiety have a tendency to deliver decline in test scores, rendering poor academic performance (Ali & Mohsin, 2013; Burns, 2004; Cassady & Johnson, 2002; El-Anzi, 2005; Khalid & Hasan, 2009; Udeani, 2012; Vogel & Collins, 2002). The amount of test anxiety that will be elicited by testing situations such as purpose of the

test (evaluative and developmental); confidence on test performance (effort translated into meeting acceptable test performance); test format familiarity (amount of prior experience towards test and item format); and nature of test content (whether the test measures learned skills and natural abilities) may be determined by intra-individual variables like age, gender, ability, and trait anxiety (Reeve, Bonnacio, & Charles, 2008).

Achievement and Moving Examination in Science

Testing is considered as one of the best techniques to evaluate and develop teaching strategies and learning outcomes (Firestone, Schorr & Monfils, 2004). In higher education, testing is commonly used to predict academic performance of students. The grade average given to students is indicative of their academic capability and may also be used as a probability of finishing their education. Thus, it is assumed that test performance in school is a good estimate of future professional performance (Demiray & Tasdere, 2012).

In science, laboratory activity is an integral and distinctive component of the inquiry-based teaching and learning (Hofstein & Lunetta, 2002). Learning what to do and how to do the different science protocols, be it basic or advanced, is one of the important learning goals in modern science education. It is expected that students will acquire laboratory skills and use these skills to learn and re-learn science knowledge. Several studies have been conducted to determine the importance of laboratory activities in science achievement. According to Wong (2008), laboratory inquiry was linked with higher achievement among students at different demographic profiles. Campbell, Kaunda, Allie, Buffler, and Lubben (2000) observed that students get high test scores when they were focused on science concepts and laboratory procedures. Ogunniyi (2006) found that cooperative group rendered significantly superior rating on the achievement measure. Al-Naqbi and Tairab (2005) asserted significantly positive association of active engagement and participation in laboratory activities to acquisition of knowledge, process skills, and scientific attitudes. Dahlstrand and Coster (2011) also inferred positive causal relationship between level of participation and acquisition of science process skills. Particularly in biology, Yara (2009) showed that active participation in hands-on activities positively enhanced interest in the subject.

The importance of using the laboratory as an important tool in science learning is already established based on various researches in science education. Thus, if laboratory-based inquisition is important,

assessment must be done to determine what the students have learned in the laboratory. Performance-based test is a task-related assessment that aims to measure students' academic knowledge and skills performance. In science education, this type of test is essential to determine students' achievement. Shavelson and Huang (2003) pointed out that both the conventional and performance based test can measure cognitive outcome, but the latter focused on both knowledge and performance abilities. Additionally, performance-based test renders better predictive validity than conventional academic predictors, for example, written examination, in relation to academic performance (Tanilon, Vedder, Segers, & Tillema, 2011).

In the Philippines, one way to assess laboratory learning is by moving examination (practical test). Moving examination is a type of laboratory exam that measures students' learning of concepts and application of science laboratory skills by answering several questions in a time-defined manner. Most of the time, moving examination is conducted in a laboratory where the teacher prepares several test stations having each station relatively apart from the other. For each test station, several test questions are given. The questions may measure comprehension of science concepts or application of laboratory skills. Depending on the number of question and on the level of difficulty, the teacher give an exact time for each student to answer all the questions for each station. The moment the time required to complete the task for a single station is complete, students move to the next station. This exercise is finished when all of the students have already completed the route of the test stations.

Process Skills

Science process skills are believed to ensure the attainment of scientific literacy. These science process skills like observation, communication, classification, measurement, inference, and prediction are considered the groundwork of scientific method. Also, these skills lead to an in depth understanding and application of acquired knowledge that consequently results to metacognition. It is important to consider that for science teaching to be significant, it must sufficiently mirror the nature of science in a sense that it must not focus merely on process-oriented skills, but most importantly, it must accentuate the products of science (Akinbobola & Afolabi, 2010). Science process skills, therefore, are essential to a sturdy groundwork for effective application of scientific method which can be utilized in everyday living. Thus, it is vital effort for science educators to develop and cultivate science process skills among the students.

Attitude towards Science

Attitude has been valuable to effective learning. As an internal state, it influences one's evaluation of a situation or event that affects behavior (Senemoglu, 2000). Quality of learning outcomes is determined by students' perceptions of their teaching and learning environment. These include assessment methods, course relevance, and course load (Sansgiry & Sail, 2006). Therefore, their beliefs and values about science affect their attitude towards the course (Robinson, 2012). Bennet (2003) stressed that attitude towards science developed from students' evaluation of their experiences on science education. One of the most common examples concerning the latter is test anxiety. Udeani (2012) explained that test anxiety arises from academic or intellectual evaluative situation causing intense anxiety leading to difficulty in adequately studying for and performing on their examinations.

Many factors could affect the student's attitude towards studying science. Several studies (Adesoji & Raimi, 2004; Berg, 2005) revealed that positive attitudes of student in learning science tend to decrease from biology to chemistry to physics and lastly, to mathematics. Adesoji and Raimi (2004) recognized the factors connected to students' attitude towards science. These factors are teaching methods, teachers' attitude, influence of parents, gender, age, cognitive styles of students, career interest, social view of science and scientific world, social implication of science, and achievement.

Conceptual Framework

In view of the literatures presented, Figure 1 shows how test anxiety will affect students' achievement, process skills, and attitude towards science.
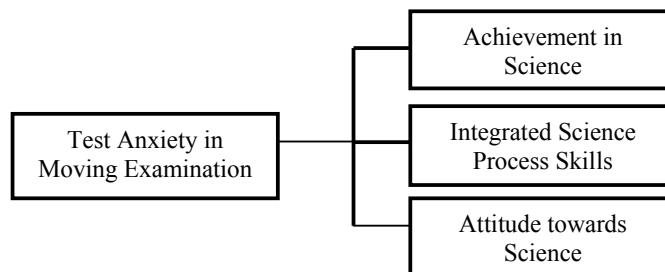

Figure 1. Conceptual framework of the study

Method

The study utilized the correlational research design to examine how the test in moving examination (the predictor variable), would affect students' achievement, integrated process skills and attitude towards science (the criterion variables).

Sample

Purposive sampling was utilized, so that there would be representative class for each discipline, namely, biology, chemistry, and physics. All classes have a laboratory counterpart. A total of 109 students participated in the study: 41 biology, 39 chemistry, and 29 physics students. In the given sample size, 69 were girls, and 40 were boys. Their age ranged from 17-20 years old, with a mean age of 18.5 years ($SD = .78$).

Instruments

Test Anxiety Questionnaire (TAQ). This study used the revised form of TAQ (Student Learning Assistance Center of Texas State University, 2002) originally developed by Suinn (1969). This revised form of TAQ is a 48-item Likert scale inventory to be rated on 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In the present study, Cronbach alpha was found to be .84, thereby, lie in the accepted range of .70 to 1.00 (Fraenkel & Wallen, 1993).

Science Moving Examination (SME). It is a teacher-made open-ended questionnaire consisting of ten (10) stations that is answerable in 2 minutes per station. There are two questions per station. Each open-ended question is accompanied by a rubric. Three SME was utilized in the study - one for biology, chemistry, and physics each. The SMEs were content and face-validated by three experts in biology, chemistry. and physics. Topics included in the SME-Biology are microscopy, cells, osmosis, and cell division. On the other hand, topics included in the SME-Chemistry are hydrocarbons, distillation, physical constants (e.g., melting point and boiling point, pH determination, solubility determination, and test for instauration). SME-Physics includes topics in measurement, scalars and vectors, and motion. In the present study, Cronbach alpha was calculated to be .76 for SME-Biology, .72 for SME-Chemistry, and .80 for SME-Physics.

Integrated Science Process Skills Test (ISPST). This test (Mungandi, 2005) measures five domains of integrated science

process skills: (1) identifying and controlling variables; (2) defining operationally; (3) stating hypothesis; (4) designing investigations or experimenting; and (5) graphing and interpreting data. Espinosa et al. (2013) localized the ISPST which are familiar to Filipino students ($\alpha = .76$). This study used the localized version and acquired Cronbach alpha of .79.

Attitude towards Science Inventory (ATSI). The modified version of ATSI (Schruba, 2006) originally developed by Gogolin and Swartz (1992) consisted of 36-item inventory having six domains: (1) Perception of the science teacher; (2) anxiety toward science; (3) value of science in society; (4) self-concept in science; (5) enjoyment of science; and (6) motivation in science. Responses on ATSI were rated on 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach alpha of ATSI was found to be .92 on the present sample.

Procedure

Data were gathered during the mid-term examination period of the first semester, School Year 2013-2014 in a private collegiate institution in Manila. Students were briefed about the purpose of the study and individual consent was acquired. They were also assured of confidentiality of personal information. The Science Moving Examinations was given first. Then, the TAQ, ISPST, and ATSI were given, respectively, right after conducting the moving examination to eliminate possible threats to validity such as place and time.

Results

Scatter plot was used to determine if the relationship between variables (e.g., test anxiety and achievement) is linear, nonlinear, or uncorrelated. Pearson's Product Moment Correlation was used to identify the strength of linear relationship.

Test anxiety and students' achievement in science. Pearson's *r* indicated that test anxiety and achievement in science has a nonsignificant relationship ($r = .09$, $p = .16$). This shows that test anxiety does not have relationship with achievement in science.

Test anxiety and students' integrated science process skills. Pearson's *r* indicated that test anxiety and integrated science process skills has a nonsignificant relationship ($r = -.06$, $p = .25$). This shows that test anxiety does not have relationship with acquisition of integrated science process skills.

Test anxiety and students' attitude towards science. Pearson's *r* indicated that test anxiety and attitude towards science has a nonsignificant association (*r* = -.03, *p* = .38). This shows that test anxiety does not have relationship with attitude towards science.

Discussion

This study examined the resulting outcome of test anxiety in moving examination to students' achievement, process skills, and attitude towards science. Specifically, it aimed to investigate the extent to which test anxiety in moving examinations predicted the outcome of these variables. Students of science with laboratory courses such as chemistry, biology, and physics were used as samples. Results showed that test anxiety in moving examinations is not significantly related to students' achievement, process skills, and attitude towards science. Participants' attitude towards science and test anxiety falls on the average. Meanwhile, their integrated science process skills, despite the fact that most of them did not even get 50% correct answers, but their average score indicate that students gained a fair amount of these skills.

These findings contradict a lot of researches. Numerous studies revealed the inverse relationship among attitude towards science, test anxiety, and academic achievement in science. High test anxiety lead to poor attitude towards science; hence leading to lower rate of academic achievement; conversely, lower levels of test anxiety yields better attitude towards science which results in higher academic achievement (Ali & Awan, 2013; Anwer, 2012).

Similarly, looking into the profile of the sample, 29% were male while 71% were female participants. Many studies showed that female participants experience higher test anxiety than male (e.g., Asghari Rusnani, Habibah, & Maznah, 2012; Essau & Sakano, 2004). Furthermore, Khalek (2002) mentioned that adolescents ages 14-18 years old may show high level of test anxiety; however, results show that only a fair amount of it was reflected. This indicates that the participants were able to overcome their test anxiety. In an interview with the science teachers who participated in the study, shared that during laboratory periods, students were actively participating and cooperating in different activities. Likewise, Al-Naqbi and Tairab (2005) found that there is a significant positive relationship between active engagement and participation in laboratory activities and students' acquisition of knowledge, process skills, and scientific attitudes.

Similarly, Dahlstrand and Coster (2011) found that acquisition of science process skills can positively predict student's level of active participation. Furthermore, Ergul et al. (2011) have shown that the use of inquiry-based teaching methods, such as laboratory work, significantly enhances students' science process skills and scientific attitudes. Apparently, the respondents have already acquired the knowledge and integrated science process skills prior to taking the test; thus, expressing lesser degree of test anxiety. This shows that students with moderate levels of anxiety have the tendency to acquire reasonable degree of integrated science process skills as well. These findings are quite in line with earlier evidences (e.g., Burns, 2004; Cassady, 2004; El-Anzi, 2005; Khalid & Hasan, 2009; Udeani, 2012); which asserted that students having low level of test anxiety has higher academic performance; while, students having higher level of test anxiety has lower level of academic performance. Therefore, students with fair amount of test anxiety also have intermediate academic performance. Results of the science moving examination, other hand, contradicts that of the integrated science process skills because most of the students failed in the 85-point test. Hill and Eaton (as cited in Burns, 2004) said that the level of time pressure during the examination would cause a change in the level of test anxiety, which affects academic performance. It is possible that students find the integrated science process skills test easy even though results showed that most of them did not even get 50% of the total items corrected.

Conclusively, nonsignificant predictive value of test anxiety to other constructs in this study can be attributed to its moderate level of anxiety found in the subjects. Thus, overall academic performance was fairly positive. This is in accordance with the Yerkes Dodson Law (Yerkes & Dodson, 1908) highlighting the relation between stimulus strength and habit-formation for tasks varying in discrimination difficulty. Apparently, effective performance is manifested when the optimal level of arousal falls on the mid-range, instead of being on the lower or higher extremes. Hence, the classroom environment, particularly, those factors related to student learning such as teaching methods, teaching attitudes, and cognitive styles of students (Adesoji & Raimi, 2004), are already on the average range. Therefore, it facilitated positive science learning outcome.

Conclusion and Recommendations

The results suggest that higher achievement in science, acquisition of integrated science process skills, and development of positive attitude towards science are not significantly correlated to test anxiety after all.

Likewise, test anxiety does not significantly predict the outcomes of these variables. Fair amount of test anxiety, therefore, yield a more positive outcome in sciences courses. It is thereby suggested that science educators should create means to facilitate the presence of test anxiety to achieve favorable results.

For researchers in science education, it is suggested to investigate the possible correlation of test anxiety to students' conceptual understanding, critical thinking skills, problem-solving skills, decision making skills, and self-efficacy. Moreover, the design of the data gathering procedure is recommended to be modified. Rather than administering the test anxiety questionnaire after the science moving exam, it is recommended to be given prior to the aforementioned examination.

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