Cognitive attributes, physical and psychosocial aspects of learning environment: Its relationship to learners’ chemistry achievement

Maris Jade Q. Orongan¹, Edna B. Nabua²*, Manuel B. Barquilla², Amelia T. Buan², Ellen N. Inutan², and Chokchai Yuenyong³

¹Central Mindanao University, Bukidnon, Philippines
²MSU-Iligan Institute of Technology Tibanga, Iligan City, Lanao del Norte, Philippines
³Khon Kaen University, Thailand

*corresponding author’s e-mail: edna.nabua@g.msuiit.edu.ph

Abstract. The objective of the study was to determine the cognitive attributes, physical aspect and psychosocial aspects of students’ learning environment on their science performance. A total of one thousand one hundred twenty-three Grade 10 science students in six divisions of Region X, Philippines participated in the study. A triangulation technique was applied in which data were obtained from the survey instruments, semi-structured interview, class observation and literature review to ensure the validity and accuracy of the results of the study. This study utilized descriptive correlational and causal comparative research design. The results revealed that students performance in science was of low mastery level with a very satisfactory average grade during elementary, having a satisfactory average of all the science subjects taken from Grade 7 to Grade 9 and with a description of moving towards mastery in their scientific ability of the National Career Assessment Examination (NCAE) result. In the psychosocial aspects, the participants generally practiced their science activities in both laboratory and classroom environments. They possessed moderate confidence in their emotion and self-efficacy in chemistry, having average science process skills and with very satisfactory science teachers. Cognitive attributes such as Junior high school science general weighted average, elementary general weighted average, and National Career Assessment Examination result and psychosocial aspects like classroom learning environment and teacher quality were significantly correlated with science performance of which the Junior high school science average (β = 0.194), elementary average (β = 0.096) and classroom learning environment (β = 0.132) were the predictors of science performance. The study puts forth the notion that the most fitting structural model of students’ performance in science is when it is anchored on the cognitive ability of the students and supported by their physical aspect of science leaning environment. Students with high cognitive ability supported by conducive, well-equipped physical facilities in science, expectedly perform better. It is recommended that the stakeholders may anchor their learning modules and activities on the different levels of learners’ cognitive abilities and needs. Likewise, they may provide public secondary schools with adequate learning resources to have an optimal learning in science to cope with the demands of 21st Century towards quality science education for all.
1. Introduction

Competencies can escalate from multiple areas of education- in natural sciences or social sciences, for instance. However, many literature sources have cited that students find areas most especially science-related subjects, and in this case, chemistry, as a difficult and irrelevant subject because of its abstract nature (Cardellini, 2013; Sirhan, 2007; Treagust, Duit and Nreswandt, 2016; Woldeamanuel and Engida, 2014). This notion results to students failing in their chemistry subjects (Arbutante, 2010).

Moreover, the globally poor performance of students in science was also reported in the International Science Study and International Assessment of Educational Achievement (Imam, Mastura, Jamil and Ishmael, 2014), and Trends in International Mathematics and Science Study (TIMSS, 1997 and 2003). These assessment studies conclude that Filipino students may still lack the scientific knowledge and skills to meet the globalization demands of the 21st Century education. For almost three decades, there is a significant growing literature of students’ perception of the learning environment which was measured using Science Laboratory Environment Theory (SLEI) (Che Ahmad et al., 2010, 2013, and 2014; Osman, Che Ahmad, and Halim, 2011). What Is Happening In This Class (WHIC) (Aldridge, Fraser and Huang, 2010; Iram and Ambreen, n.d.; Murugan and Rajoo, 2013 & Treagust, 2003) and self-efficacy (Dorman and Fraser, 2009; Kolo, Garba, Jaafar, and Binti, 2017). Many literatures cited have pronounced that conducive and favorable learning environment can contribute to the enhancement of students’ academic achievement. In addition, psychosocial variables such as emotional intelligence (EI or EQ), high school chemistry self-efficacy, science process skills and teacher characteristics are found to have a positive and significant influence towards students’ academic performance (Abungu, Okere, and Wachanga, 2014; Kolo et al., 2017; Oloyede, 2012 & Preeti, 2013).

Hence, this study was conducted to ascertain the factors that could significantly contribute to junior high school (JHS) students’ academic performance. Results of this study are expected to serve as imperative for government stakeholders such as DepEd officials, school administrators, curriculum makers and teachers on the areas where improvements can be made to promote the quality of teaching and learning in science. Likewise, the study sought to provide effective remedies to the problems faced by the young students who are performing low in science. Specifically, the study geared to:

1. find out the level of performance of students in Grade 10 science:
2. determine the level of cognitive attributes of Grade 10 students with respect to each student’s:
   • General Weighted Average (GWA) in Grade 6
   • General Weighted Average (GWA) in science in the Grade 7 to Grade 9 and
   • scientific ability derived from National Career Assessment Examination (NCAE)
3. ascertain the level of the physical aspect of the science laboratory environment of Grade 10 students in terms of:
   • furniture and equipment/learning space
   • technology
   • lighting
   • air quality
   • safety items
4. correlate academic performance to the cognitive attributes, and physical aspects of science learning environment of the Grade 10 science students

2. Methods

This research used a mixed-method approach involving quantitative and qualitative data. This method applied the triangulation technique in which data obtained from the survey instruments, semi-structured /one-on-one interview, class observation and literature review. This was done to strengthen and ensure the validity and accuracy of the results of the study.

In the quantitative approach, descriptive-correlational and causal-comparative designs were employed. The descriptive-correlational design was utilized to determine the results of students’ performance of their science learning environment- cognitive factors, physical and psychological aspects in relation to academic performance in science. The causal-comparative research design was employed to determine the influence of the cognitive attributes and physical aspects of the students’ classroom/laboratory environment on their science academic performance. Structural equation modeling (SEM) was used to find out what model best links to the academic performance of Grade 10 students in science. This would serve as basis of improving the science learning environment of the students towards effectiveness in learning.
In the qualitative approach, a semi-structured interview was employed to validate the students’ answer on their performance with respect to science learning environment, emotional quotient, high school chemistry self-efficacy, science process skills and teacher quality. A class observation was also conducted to some science teachers to further validate the students’ responses on the Teacher Quality instrument. An intensive literature review and studies were gathered for the different variables employed in the study.

Moreover, the data collected from the respondents for the three methods (in yellow, Figure 1) were compared and then were triangulated in the interpretation phase of the study.

2.1. Research Setting
This study covered nine (9) public secondary schools in randomly selected school divisions of Region 10, Philippines. It comprises five provinces: Camiguin, Misamis Oriental, Lanao del Norte, Bukidnon and Misamis Occidental and two cities classified as highly urbanized, all occupying the north-central part of Mindanao island, and the island-province of Camiguin. The regional center is Cagayan de Oro (https://en.wikipedia.org/wiki/Northern_Mindanao).

The province of Bukidnon is comprised of three divisions, namely; Bukidnon, Malaybalay City and Valencia City. However, DepEd-Division of Bukidnon is the biggest bureaucracy of DepEd in Region X (http://www.depedbukidnon.net.ph/). Cagayan de Oro City, Iligan City and Misamis Oriental, the other divisions were included in the study. These public schools have a large population of high school students. The researcher strongly believes that they can provide reliable information for the study.

2.2. Research Instruments
There were eight instruments employed during the collection of data. This was to determine the level of performance of Grade 10 science students in terms of physical and psychosocial aspects of the science learning, emotional quotient, high school chemistry self-efficacy, science process skills, teacher quality and achievement test in science. After the content validation, the instruments were pretested and piloted to Grade 10 students for reliability to ensure internal consistency using Cronbach’s alpha. The content validity and reliability of these instruments (ranging from 0.78 to 0.96) were carefully done for temporal, spatial and ethical considerations. These instruments were pilot-tested to more than 100 students from the three sections in Grade 10 of Central Mindanao University-Laboratory High School (CMU-LHS) last May 2016.
Experts on content and pedagogy validated the content of the survey instruments and science achievement test. Three of them hold a degree of Doctor of Philosophy (PhD) in Science Education (Major in Chemistry) from the University of the Philippines (Diliman) (1) and De La Salle University (2), Manila respectively. They are professors of University of San Carlos (1), Cebu City and Notre Dame University, Cotabato City. The fourth one earned her degree of Doctor of Philosophy in Chemistry at the University of Adelaide, Australia. She is a full professor, Chemistry Department, College of Arts and Sciences of Mindanao State- Institute of Technology. The latter local expert only validated the content of the achievement test in science.

Table 1 Summary of the Different Instruments Used for Physical and Psychosocial Aspects of Science Learning Environment.

| Instrument                                      | Person(s) Developed       | Use(s)                                                                 |
|-------------------------------------------------|---------------------------|----------------------------------------------------------------------|
| 1. Physical Aspect of Science Laboratory Environment (PASLEI) | Che Ahmad, Osman & Halim (2014) | • To assess students’ performance in relation to the physical environment with respect to furniture and equipment, space, technology, lighting, air quality and safety items. |
| 2. Science Laboratory Environment Inventory      | Fraser, McRobbie & Giddings, 1993 | • To evaluate students’ performance of their science laboratory environment in terms of the five (5) scales: student cohesiveness, open-endedness, integration, rule clarity, and material environment, and • To examine what makes the laboratory unique. |
| 3. What is Happening In This Class (WIHIC)       | Fraser, McRobbie & Fischer, 1999 | • To measure the students’ performance in their learning environment in terms of student cohesiveness, teacher support, involvement, investigation, task orientation cooperation, and equity. |

2.3. Research Subjects
The participants were Grade 10 students of the public secondary schools in six divisions of Region 10. The names of the schools’ respondent are listed in Table 2 with the corresponding number of Grade 10 enrollees (SY 2017-2018) and the desired sample size per stratum. For Structural Equation Modelling, the more samples, the more fitting the model is, however, a good rule of thumb is >15 cases per predictor/indicator was considered (Stevens, 2012).

Table 2 Respondents from Different Secondary School Divisions in Region 10.

| DepEd Divisions       | Code | No. Grade 10 enrollees SY 2017-2018 | Sample size |
|-----------------------|------|-----------------------------------|-------------|
| Cagayan de Oro City   | C1   | 205                               | 37          |
| Bukidnon              | B1   | 96                                | 86          |
|                       | B2   | 205                               | 132         |
|                       | B3   | 529                               | 112         |
| Iligan City           | I1   | 558                               | 145         |
| Malaybalay City       | M1   | 1309                              | 271         |
|                       | M2   | 108                               | 78          |
| Misamis Oriental      | MO1  | 403                               | 85          |
| Valencia City         | V1   | 940                               | 177         |
| **TOTAL**             | **9**| **4353**                          | **1123**    |
The researcher humbly requested permission from the Regional Director of Department of Education (DepEd). Another letter of request was forwarded to the School Division Superintendents of the six divisions in Region X - Northern Mindanao in their respective school divisions. A letter of request was then forwarded to the School Principals asking permission to conduct the study involving their Grade 10 high school students as research participants. Second, through the students’ class advisers and subject teachers. A Consent Form with attached cover letter was provided to the students.

In this research study, Central Mindanao University-Laboratory High School was chosen school for the pilot testing of the seven instruments and the science achievement test. The school has shifted its academic calendar this SY 2016-2017 and has a different science curriculum compared to DepEd secondary schools.

Stratified random sampling using proportional allocation was employed to obtain the students who served as participants. There were nine (9) national high schools. However, a total of 1000 respondents or more was set. To obtain the percentage proportional allocation of each division, the researcher simply computed the ratio of the desired sample size and the total number of participants and multiplied by 100.

The data necessary for the study were collected through the seven survey questionnaires for cognitive characteristics, physical aspects of science laboratory environment, psychosocial aspects of science learning environment, and the achievement test in science. Before the survey questionnaires was administered to the participants, the researcher provided them a preliminary orientation about the study. They were informed that the complete results of the survey and their performance in the achievement test will be kept confidential. The data collected were then tallied, tabulated, and analyzed.

On the qualitative aspect of the study, a semi-structured interview was conducted. Five (5) students for each school respondent were interviewed, however, the same ethical process for the survey questionnaire were undertaken by the researcher for this aspect. Students’ responses were patiently recorded, transcribed and translated the vernacular responses to English language for thematic analysis purposes that is in terms of frequency. Data that were obtained from this interview would further deepen the results of the study and provide tangible, compelling.

2.4. Cognitive Attributes of Grade 10 Students
This study used the students’ general weighted average in elementary (Grade 6) and in science grades from Grade 7 to Grade 10. This is to ascertain the relationship with respect to their level of academic performance. The following grading scale and descriptive rating were employed in the study based on DepEd Order #8, s.2015:

| Grading scale | Descriptive Rating        |
|---------------|---------------------------|
| 90-100        | Outstanding               |
| 85-89         | Very satisfactory         |
| 80-84         | Satisfactory              |
| 75-79         | Fairly satisfactory        |
| 74 and below  | Did not meet the expectations |

Their NCAE results taken in Grade 9 level (i.e. SY 2015-2016) were formally requested from their School Guidance Counsellor in their respective school. This served as secondary data.

2.5. Qualitative Data
The results of the quantitative data of the study were underpinned by the gathered review of literature and studies of the different variables, students’ oral interview and class observation of the science subject teachers handling the chemistry lessons for the Fourth Grading, SY 2017 to 2018.

Before the one-on-one interview, permission from the section adviser/science subject teacher was humbly asked to conduct the interview for five Grade 10 students only per school for validation purposes of the instrument.

A brief orientation was given to the students on the purpose of the interview, and requested to fill up the consent form for the research participants voluntarily. The researcher provided a simple introduction about herself and greeted the students warmly to establish a positive atmosphere before the interview, Guide questions (validated by three local experts) were also provided to students to internalize the questions by encouraging them to use the papers to organize their answers. A formal one-on-one interview was followed to have an in-depth
response of the student participant from the given questions. All students’ response were recorded, transcribed, consolidated and subjected to content analysis in terms of frequency.

Validation of the instrument on teacher quality was done through class observation of the subject science teacher, either announced or unannounced. Permission from them was sought before the conduct of the class observation. At the end of the observation, the researcher showed the filled up form. There was an exchange of ideas, suggestions on the current status of science education, especially in DepEd system. The subject teacher signed the form. Results of the teacher’s actual observation were summarized, and consolidated to determine the frequency of the items in the Observation Checklist.

3. Results and Discussion

Out of one thousand one-hundred twenty-three (1123) student participants, only three of 0.27% are on the range of 66 to 85% rating described as moving towards mastery (Table 3). It can be noted that almost 40% of the students were on the average mastery (38.02%). Further, more than 60% of the students obtained a percentage rating score ranging from low mastery to no mastery at all. The overall performance of students for the six divisions of Region X is 32.42%, indicating low mastery. This implies that majority of the respondents had difficulty to grasp the scientific concepts introduced to them.

| RANGE (%) | FREQUENCY | PERCENTAGE (%) | DESCRIPTIVE EQUIVALENT |
|-----------|-----------|----------------|------------------------|
| 96 - 100  | 0         | 0              | Mastered               |
| 86 - 95   | 0         | 0              | Closely approximately mastery |
| 66 - 85   | 3         | 0.27           | Moving towards mastery  |
| 35 - 65   | 427       | 38.02          | Average mastery        |
| 16 - 34   | 659       | 58.68          | Low mastery            |
| 5 - 15    | 33        | 2.94           | Very low mastery       |
| 0 - 4     | 4         | 0.89           | Absolutely no mastery  |
| TOTAL     | 1123      | 100%           |                        |

The results further implied that the students obtained low performance towards mastery of the learning competencies in understanding the concepts, theories and principles in science. Thus, students still lack the scientific knowledge and skills to meet the globalization demands of the 21st Century Science Education. York (2015) found that students’ academic performance in the form of grades and GWA can assess the cognitive skills to measure students’ academic success.

Banerjee (2016), King ‘Aru (2014) & Mulela (2015), report that shortage of learning resources such as laboratory rooms, facilities, materials, and unfavorable learning environment are the perennial reasons for the poor performance of students in their science subjects. Other factors that possibly account for such unsatisfactory performance of students include teachers’ heavy teaching assignments, traditional teaching strategies used in imparting the subject matter, limited students’ learning experiences, students self-efficacy, less perseverance in understanding the science concepts as the topics become complicated, students’ low confidence with the science knowledge and skills, lack of parents’ and teachers’ support and low level of emotional quotient (Oyinloye, cited in Nwadinigwe & Azuka-Obike, 2012, p. 395).

The results of students’ achievement test agree with the literature of Atagana & Engida, (2014), Cardellini, (2013), Sirhan, (2007) & Woldeamanuel et al. (2016), which put forward the notion that many students find science subjects (such as chemistry) very difficult to comprehend because of its abstract nature. Likewise, the reports of Benito (2014) and Briones (2014) on the low performance of Filipino students in the two national examinations, NCAE and NAT (in science area) also conform to the research outcomes of this study.

Knowingly, science teachers play a crucial role in the holistic development of student’s personality. To meet this challenge, they may allot more time for students to achieve mastery of the subject matter, acquisition of 21st century skills (e.g. critical thinking, creativity) and values to ensure that the topic has been understood by heart. According to Newmann and Wehlage, as cited by Doll (1996, p.89), science teachers perhaps create a classroom environment that is well-organized to facilitate students’ learning.
Therefore, all stakeholders responsible to alleviate students’ poor performance may work together to improve the science curriculum that will expectedly yield positive impact towards the improvement of students’ academic achievement and transform them into life-long learners.

3.1. General Weight Average (GWA) in Elementary Level

Table 4 shows the students’ general weighted average in their elementary level. The overall mean percentage score (MPS) is 85.37, which denotes very satisfactory. This implies that students had a very satisfactory grade performance in all their subjects during their primary level.

Generally, teachers provide summative evaluation in terms of general weighted average (GWA), or subject grade to students to determine their level of content and procedural knowledge and what they have learned about their subject. According to Airasian, cited by Lipnevich & Smith (2008, p. 4), grades can serve as motivation to encourage students to try harder. GWA and grades are the most appropriate variables to assess students’ academic success (York, 2015).

The findings conform to the improved results of the National Achievement Test (NAT) in the elementary level (68.88%), however it was not able to reach the 75% MPS target for national standards. Inadequacy of school facilities, weak reading comprehension, lack of science literacy and computational skills may be attributed to satisfactory performance of students in their GWA.

| RANGE       | FREQUENCY | PERCENTAGE | DESCRIPTIVE EQUIVALENT |
|-------------|-----------|------------|-------------------------|
| 90-100      | 138       | 12.29      | Outstanding             |
| 85-89       | 532       | 47.37      | Very satisfactory        |
| 80-84       | 364       | 32.41      | Satisfactory             |
| 75-79       | 89        | 7.93       | Fair satisfactory        |
| 74 and below| 0         | 0          | Did not meet the expectation |
| TOTAL       | 1123      | 100%       | VERY SATISFACTORY        |

Thus, elementary teachers may be innovative and creative in their learning materials and activities that will effectively enhance students’ reading comprehension, and hone their skills in science and mathematics as well. As a result, students will yield a remarkable performance in all subject areas, especially in science.

3.2. General weighted average (GWA) in Science Grade (Grades 7-9)

The overall MPS is 84.42%, which equates to very satisfactory. This implies that Grade 10 students in the six division of Region X (Northern Mindanao) still needs to improve their conceptual and procedural knowledge in science to master the learning competencies set by their science teachers. In effect, this will expectedly produce good results in students’ learning performance.

| RANGE       | FREQUENCY | PERCENTAGE | DESCRIPTIVE EQUIVALENT |
|-------------|-----------|------------|-------------------------|
| 90-100      | 198       | 17.63      | Outstanding             |
| 85-89       | 517       | 46.04      | Very satisfactory        |
| 80-84       | 277       | 24.67      | Satisfactory             |
| 75-79       | 130       | 11.58      | Fair satisfactory        |
| 74 and below| 1         | 0.089      | Did not meet the expectation |
| TOTAL       | 1123      | 100%       | SATISFACTORY             |

The results of this study supports the findings of Bernardo et al. (2008) that assessment procedures of students performance and the use of science grade in different higher levels (Grade 7 to Grade 10) did not reflect their actual learning. Students may be given credit for the successful attainment of the science curriculum goals without actually doing it. According to Page (quoted by Lipnevich & Smith, 2008, p.7), grades could be effective for the promotion of students’ learning when accompanied by a comment. Therefore, science teachers...
may provide assessment tools that would align with the learning goals in order to measure the learned knowledge and acquired skills of the students.

3.3. Students’ Performance on the National Career Assessment Examination (NCAE)

The overall NCAE performance of the students has 66.47% MPS, best described as moving towards mastery. The result implies that students’ performance in terms of scientific ability in NCAE is moving towards mastery of the scientific concepts studied in their science class, in fact, one step higher than average mastery.

| RANGE  | FREQUENCY | PERCENTAGE | QUALITATIVE DESCRIPTION     |
|--------|-----------|------------|------------------------------|
| 96 - 100 | 146   | 13.00     | Mastered                    |
| 86 - 95   | 166   | 14.78     | Closely approximately mastery|
| 66 - 85   | 402   | 35.80     | Moving towards mastery       |
| 56 - 65   | 261   | 23.24     | Average mastery              |
| 16 - 34   | 104   | 9.26      | Low mastery                  |
| 5 - 15    | 40    | 3.56      | Very low mastery             |
| 0 - 4     | 4     | 0.36      | Absolutely no mastery        |
| TOTAL     | 1123  | 100%      |                              |

OVERALL MEAN 66.47% MOVING TOWARDS MASTERY

The performance of students may be attributed to students’ personal experiences in their environment by giving them opportunity to construct new knowledge, and ideas. This is in accordance to Piaget’s Cognitive Development. He believes that a constructivist classroom must provide students multiple activities that will challenge them to accept individual differences, discover new ideas, and construct their own knowledge (Batian & Sabaldana, 2018).

However, result of this study does not conform to the findings of Bernardo et al. (2008), Imam et al. (2014), and the reports of Benito (2014) & Briones (2014) for the low performance of Filipino learners in the NCAE and NAT in the area of science respectively. Thus, teachers may possibly apply effective teaching strategies to cultivate students’ interest and radiate the positive scientific attitudes towards an improved educational performance in science.

3.4. Physical Aspect of Science Laboratory Environment

The physical aspects of the science laboratory environment are composed of (a) furniture and equipment, space, (b) lighting, (c) technology, (d) air quality, and (e) safety items are germane to effective students’ learning and academic performance. Learning is the core of Department of Education for students’ holistic development. Physical facilities play an important role in providing quality performance of students in conducting laboratory activities.

3.4.1. Furniture, Equipment/Learning Space Scale. The mean scores of the furniture, equipment and learning space of physical aspects of science learning environment inventory were computed and assessed. This ascertain the strengths and weaknesses of the science laboratory environment of the student participants, as basis for its enhancement towards effective learning in science. The study found that the layout of furniture (3.02) and chairs (3.00) in students’ laboratory environment make them comfortable while doing their laboratory work; the space is enough for them to move and their laboratory is also equipped with adequate materials (2.98). The lowest mean (2.68) accounted to the statement that said the number of students in a science laboratory is not more than 50. The overall mean (2.92) indicates that the level of furniture, equipment and learning space is moderate.

This results find support to the findings of Che Ahmad et al. (2010, 2011, 2014) and Puteh et al. (2015), which revealed that furniture and learning space is in moderate level. The design of tables and chairs make students feel uncomfortable to be used for an extended period of time. The learning space seems not suitable for the class size where the students cannot freely interact with others for discussion and sharing of insights about the activity. This will create an effect on the learning outcomes of the students.

Below are some of the verbatim answers of the students during interview:
Yes, our laboratory have enough space for the students to work their experiments, but sadly, we don’t have the equipment/materials for the laboratory and for the students. (B1.5)

No, because it is too small ... for us. (B2.2)

Our classroom as laboratory ...enough... enough cia mam...dili ka maka ingon na gu-ot cia mam... (Our classroom serves as our laboratory room. It is enough and you cannot say it is congested.) (B3.3)

No ma’am, we can’t move easily because of the occupied space and some of the students are just standing. (I1.5)

Gamay... gamay ra... (The laboratory working area is only small.) (M2.5)

Sometimes, kung daghan tao, sikit kayo kung gamay ra luag kaayo... (Sometimes if there are many students in the laboratory, we are very close to each other. The area will be spacious if there are few students in the room.) (MO1.3)

No ma’am, the space is not enough to conduct the experiment because the tables ma’am... are huge and they are so close to each other... so we cannot work properly. (V1.3)

The responses of the students expose the limited space of their laboratory room in carrying out an activity, which may affect the accuracy of their resulting data, and performance as well. This will also affect their interest in doing science activities.

Hence, this physical feature of the laboratory be given attention by the School Heads and other government officials to formulate provision for a comfortable movement of students around the laboratory. To the teachers, they may create a safe working science laboratory environment that will allow students to work comfortably and can sustain their interest in performing their tasks completely.

3.4.2. Lighting Scale. The following statements under the lighting scale include brightness of light in the laboratory that can illuminate the science laboratory across the room (2.94), and the lighting that can be adjusted according to the needs of their learning activities (2.80). The science laboratory can be darkened when the lesson calls for it (2.65). The overall mean (2.80), which is described as moderate. This implies that the lighting condition in the laboratory is poor. It does not fully performed its function.

The finding of Puteh et al. (2015) agrees with the result of this study, but it negates to the findings of Che Ahmad et al. (2010, 2011, & 2014), who found that there is high level of fitness for lighting scale. This study suggests that subject teachers may also conduct a regular check of the lighting condition in the science laboratory to motivate students to focus on their laboratory work as to enhance their understanding of the science concepts.

3.4.3. Technology Scale. The students responded positively to the statements that their laboratory is equipped with functioning television and LCD (2.83) and are in good condition (2.80). This produced a mean score of 2.81, which shows that the level of fitness for technology is moderate. This implies that the Information and Communication Technologies (ICT) in the science laboratory room for the nine school respondents still do not have the complete ICT equipment. The findings of this study conform to the results of Che Ahmad et al. (2010, 2011 & 2014) & Puteh et al. (2015).

3.4.4. Air Quality Scale. With respect to the air quality scale of PASLEI, it has been found that the science laboratory has a suitable temperature to allow the learning process to take place comfortably (2.88), and has adequate number of electric fans to ensure good airflow in the laboratory (2.72). Also, the exhaust fan installed in the laboratory increases the efficiency of airflow (2.58). The students’ positive responses gave an overall mean of 2.74, which can be described quantitatively as moderate level of fitness. This may be attributed to unavailability or limited number of exhaust fans, and poor ventilation in the laboratory room.

In addition, the study also found that the safety items aspect scale had a mean score of 3.09, which indicates high. Specifically, the science laboratory has two doors that function properly (3.23), equipped with a first-aid kit (3.12) and fire extinguisher (3.03). Overall mean (3.09), denotes high level of fitness. The findings of this
study conform to the results of Puteh et al. (2015), but it does not agree with previous literature of Che Ahmad et al. (2010, 2011 & 2014) who reported that there is a moderate level of fitness for safety aspects.

Based on the transcription of the oral interview, majority of the participants mentioned that there is a unit of fire extinguisher available in their science laboratory. However, out of 45 students, 15 (33%) claimed that an exhaust fan is available, and 22 (49%) claimed to have located an emergency kit found in their science laboratory room. Here are some of students’ responses which evidently support the above statements, coming from selected school divisions of Region X-Northern Mindanao: Divisions of Bukidnon (B1.2, B2.2, & B3.2), Cagayan de Oro City (C1.2), and Valencia City (V1.4).

Naa mi laboratory glasswares, naa man emergency kit, naa man fire extinguisher, exhaust fan, naa. (We have laboratory glasswares, emergency kit, fire extinguisher, and exhaust fan.) (B1.2)

Our science laboratory is not complete with equipments like exhaust fan, some emergency kit and others. (B2.2)

In our laboratory apparatus and equipment…. Science laboratory is kuan mam kuan kanang tarung pagka-plastar…emergency kit –naay daghan ug sulod na tambal, fire extinguisher gibutang sa butangangan, walay exhaust fan. (In our science laboratory, the laboratory apparatus and equipment are orderly arranged. There is an emergency kit with a lot of medicines inside. The fire extinguisher is placed on a receptacle; no exhaust fan.) (B3.2)

Ahm… murag para sa akoa mam kay okey…okey ra cia murag … naay …naay…murag dili kumpleto naa mi laboratory apparatus and equipment… ang kulang sa amoa ang exhaust fan. (For me, our science laboratory is okay, but it is not complete with the laboratory apparatus and equipment. There is no exhaust fan.) (C1.2)

By… kanang… kanang naka butang sa order ug kanang ug pud mga mga… mahitabo cia dali ra kuha-on. Fire extinguisher- naa mam, emergency kit – naa mam, exhaust fan – naa mam. (The laboratory apparatus and equipment are placed in order and are accessible to the students. There are fire extinguisher, emergency kit and exhaust fan in the laboratory room.) (V1.4)

The narratives of students imply that there is a dire need for DepEd officials such as the School Principals/Division Superintendents to provide the public secondary schools with sufficient learning resources to effectively educate the students to facilitate quality learning and teaching in science. They can possibly look into providing the schools adequate facilities and equipment needed in the realization of laboratory experiments. This may widen students’ knowledge and develop the 21st Century skills necessary in coping with the globalization demands towards quality science education.

4. Conclusions
The level of Grade 10 students’ academic performance measured using the standardized teacher prepared achievement test in science exhibited low in terms of mastery of the scientific concepts. This implies that students lack the necessary scientific knowledge, skills and learning experiences to unleash their difficulties in understanding concepts in science and appreciate the importance of science in their real life situations.

The cognitive attributes of the students obtained very satisfactory and satisfactory ratings for their elementary general weighted average and general weighted average in science grade, respectively. Further, their performance in NCAE scientific ability displayed moving towards mastery of the science concepts taught.

Moreover, physical aspects of science laboratory environment of the students showed moderate level of fitness. Thus, providing a well-equipped laboratory with advanced materials and equipment to cultivate students’ interest to exert effort in understanding the complexity of science.

The Grade 10 students had demonstrated positive responses in various dimensions of psychosocial aspects towards their science learning environment. Laboratory, and classroom environment were moderately practiced. Cognitive attributes such as elementary GWA, Junior high school GWA of all the science subject taken and the NCAE scientific ability found to have a significant correlation to students’ academic performance. Thus, science teachers may use the science grades as feedback to their performance.

Three variables that came out to be the predictors of science performance, namely: JHS science GWA, Elementary GWA and Classroom learning environment. Students’ grades and conducive classroom
environment would serve as motivation to enhance their science learning. The latter variable may also the
students with stimulating learning experiences that will help them augment the conceptual knowledge and
understanding of their science lessons. This kind of environment will likewise provide students’ opportunities to
develop the necessary 21st Century in depth knowledge, skills and values towards learning competence.

Generally, students with high cognitive ability supported by conducive, well-equipped physical facilities in
science, the better is the performance. The cognitive attributes were best measured in terms of students’ grades in
elementary and junior high school science subjects together with their NCAE performance (NCAEPER) in
scientific ability. Thus, theoretically, the best fitting structural model of science performance is anchored on
students’ cognitive ability coupled with the physical learning environment aspects in science.

It is recommended that Science teachers may find ways in updating or innovating strategies, methods,
approaches, and assessment tools to support instructional materials that cater to the current needs, skills and
abilities of secondary students for an effective and meaningful science learning. Hence, this will improve the
students’ understanding about the science lesson and will eventually lead to better academic performance. Pre-
service teachers may continue to have a one-week enhancement training to develop the necessary scientific
knowledge, and skills to become competent teachers in their own field of specialization.

School Administrators may ensure and encourage science teachers for continual professional growth through
attending seminars, symposia, short term courses that enhance the current trends and approaches in the teaching
of science. They may inspire teachers for collaborative researches in the area of science education, as well.

Government offices (like DepEd, DOST, CHED and others) most likely will continuously sponsor seminars,
trainings, conferences and scholarships for public science secondary teachers to provide and strengthen their
knowledge and experiences in their field of specialization in local and international arena. The Scholarship
program on Capacity Building in Science and Mathematics Education (CB in SME) may be revived in the
current DepEd administration. This will probably improve the quality of science education in the country and
develop more competent public secondary teachers that will motivate students’ interest towards their attitudes in
science. Hence, this may yield good results in the performance of students academically. Government officials,
especially at the Department of Education, may find ways of improving and maintaining physical plan in
uplifting and updating state of the art science facilities for actual and experiential learning of students
considering the nature of the science subject. Further, a laboratory technician or personnel be employed and
properly trained to handle such equipment and facilities to maximize science activities especially in the
laboratory. Further studies may be conducted using the results of this study as benchmark in improving
performance of students not only in science but also to other fields of specialization.

5. Acknowledgement
The authors would like to thanks different entities and personalities who contributed to make this study a
success. The Regional Director of DEPED in particular as well as the Schools Division Superintendents of the nine
schools division. The students also who participated as the respondents were highly acknowledged

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