Journal of Research, Policy & Practice of Teachers &
Teacher Education (ISSN 2232-0458/ e-ISSN 2550-1771)
Vol. 10, No. 1, June 2020, 1-13

Students' knowledge and process skills in learning grade-8 chemistry

Aisie O. Bete
Isabela State University, Philippines
Corresponding author: aisiebete@gmail.com

DOI: https://doi.org/10.37134/jrpptte.vol10.1.1.2020

Cite this article (APA): Bete, A. O. (2020). Students' knowledge and process skills in learning grade-8 chemistry. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, *10*(1), 1-13. https://doi.org/10.37134/jrpptte.vol10.1.1.2020

Received: 15 November 2019; Accepted: 09 April 2020; Published: 10 April 2020

Abstract

Determining the knowledge and skills of students are identified as aspects in enhancing the students' academic performance in sciences. Using the research instrument composed of test items and process skills checklist, data were gathered from 332 grade 8 students from the seven (7) public high schools in the Division of Santiago City, Philippines to assess their knowledge and science process skills in learning grade 8-Chemistry. Standard score (z-score) and descriptive statistics were used to analyzed the data. It was revealed that the student-respondents' knowledge belongs to "developing proficiency level" while their process skills were rated as poor in their grade 8-Chemistry subject. In using the *z*-scores, most of the respondents are partially proficient in their scientific knowledge and skills. Based from the result, specific topics in grade 8 chemistry that needs an intervention material were identified. These intervention materials will be subjected to validation and further assessment. In improving the level of process skills and knowledge, students are encouraged to participate in different chemistry activities and for the teachers to elevate their science instruction and students' academic performances.

Keywords: Knowledge, learning chemistry, intervention program, process skills, science education

Introduction

Chemistry as one field of science helps explain the workings of physical world that plays an important role to every individual. The structure, composition and behavior of matter are often studied in Chemistry because everything that take place in the environment is made from one or more than one chemical elements and substances. Using various kinds of chemical processes, chemists were able to create numerous products to make life easier and healthier.

Even though science has given large impact in the society, some people do not take high value of it (Movahedzadeh, 2011). In the education sector, issues on academic achievement and performance in science as an academic subject of the learners have been the main concern for school administrators and educators. Moreover, uplifting students' performance and deep understanding on the subject matter like chemistry has been the central query of science education.

In line with this, chemistry is considered as one of the most difficult subjects because chemistry topics are highly conceptual which requires higher level of skill including memorization and recall of facts and data (Sirhan, 2011). The subject also draws negative feedback among learners in the secondary level including the type of learning environment which affects the academic performance as well as conceptual reasoning skills of the learners (Oluwatelure, 2010). According to Aranes et. al. (2014), chemistry has negative impacts and opinions on learners. For example, learning is not fun, it is boring and burdensome among learners and it has been one of the hated subjects. Through these negative impacts, the learners' reasoning skills and science academic performance will probably decline.

On the contrary, Demir, Kilinc and Dogan (2012) observed that there is a gap between the students' level of cognitive abilities and the learning targets in the spiral science curriculum considering the diverse types of learners. One of the challenges faced by the teachers in implementing the spiral science curriculum is teaching difficulties to wide range of knowledge and number of science concepts and as the grade level changes, science topics become complex. Teachers also consider the various individual needs of their students

Moreover, it is studied by Abungu et al. (2014) that science process skills are developed due to the integration of concepts in real life situation particularly engaging students in activities that were likely heighten the students' interest and abilities to improve their cognitive skills towards the subject. Murphy (2005), found out also that children enjoy learning science but the level of enjoyment in learning science decreases as they leave primary schooling due to the level of difficulty of science concepts and less activities imposed by teachers. School funding to science laboratories and equipment are also considered as factors.

In the enhanced education curriculum in the Philippines, (K to 12 Curriculum), its conceptual framework is to make science learning education a continuous process in developing scientific literacy among Filipino learners. This enhanced curriculum will prepare the learners to become active and informative citizens with sound judgments and constructive decision making skills with regards to the scientific impact and applications of science knowledge in social, environmental, political and health developments.

In the K to 12 Curriculum Guide, there are domains that lie within the science curricular program: determining and applying the scientific knowledge within the country and beyond, perform the context of scientific processes and skills towards the development of new knowledge and demonstrate scientific attitude and values needed to sustain interest in learning sciences and positive approach to science education (Montebon, 2014).

In addition, there is an interrelation of science process and content because through science context, process skills are best learned by the students. Thus, integrating science and stimulating student's curiosity and motivation to learn is a challenging part to realize its usefulness and relevance to everyday living. In general, positive attitude and interest to science subjects and activities and learning environment must also be enhanced to consequently acquire and apply scientific and technological knowledge (Programme for International Students Assessment (PISA) Survey, 2018).

In order to cater to the needs of the students regarding the acquisition of knowledge and skills, various content standard achievement test, intervention materials, and modules were developed and utilized. Other programs like enhanced Science Investigatory Projects, Effective Alternative Secondary Education (Project EASE) and Engineering Science were also founded by the Department of Education and Department of Science and Technology. The Department of Education had released modules on various subjects especially in science in order to meet the standards of the newly enhanced spiral curriculum. Even with the various types of instructional modules set by the Department of Education, the following problems are being observed: some of the materials especially for the laboratory activities established within the module are not locally found, other words in the modules are hard to understand and some of the activities are time consuming (Cabili, Sequete & Capilitan, 2015).

Moreover, strategically designed instructional materials using locally available materials to deliver well the intended activities suited for the type of learners must be considered to ensure learning in teaching Chemistry (Aranes et al., 2014). This is the reason why teachers are given opportunities to enhance the learners' modules and make supplementary or intervention material especially for those who cannot easily cope with the lesson.

Conceptual framework

The society is in need of individuals who are critical thinkers, with skills in the art of questioning and those who can gain information in support to opinions using valid facts and truths. It has been shown that the substantial factors for the country's economic development are the scientific progress and technological advancement but citizens ought to enhance their scientific literacy in order to respond to the demands of the changing society as well as the continuous upgrading of current knowledge and skills (Mokyr, 2018).

Jean Piaget, on his cognitive development theory believes that school education must empower learners both men and women to do new things based on creativity, invention and discovery. These learners must verify and be critical to everything they deal with. Piaget also believes that the goal of education is not simply repeating what is being done from the past generations rather learn from it to improve more the present and future endeavor (Lillard, Lerner, Hopkins, Dore, Smith & Palmquist, 2013). In addition, an increase level of scientific literacy will help an individual to be more competitive professionals that will spearhead innovation in the field of work (Ogunkola, 2013).

The benchmark for Science Literacy: Project 2061 of the American Association for the Advancement of Science (AAAS) states that by the end of grades two, five and twelve, all students must be able to understand well about science, technology and mathematics (Roseman, Herrmann-Abell & Koppal, 2017). Benchmarks are important to help educators in describing the levels of understanding and abilities of different learners to ensure that they will become science literate. Concentrating on the common core of learning, this will help in contributing to the science literacy of the students although educators must also acknowledge that every student has their own abilities and interests to go beyond that common core and considering also their different learning difficulties.

Another challenge in the Philippine educational system is the achievement of the goals of Association of South East Asian Nations (ASEAN) SUMMIT 2015. The ASEAN as a single integrated economy, look forward to build a strong base for science and technology in order to ensure that ASEAN will remain globally competitive (The ASEAN Secretariat Jakarta- ASEAN Documents Series 2015). This will be through promoting greater awareness to the people the importance of science and technology activities in its roles and contributions for sustainable economic development. It will also provide better ways and means toward innovative development in research and commercialization of technologies and new ideologies.

In the Philippine setting, Gregorio (2012) studied that in order for an individual to achieve "scientific literacy", the inclusion of modern and latest sciences in high school curricula will become the guided path the experiences between the history and current science education. It will enhance capabilities to determine what must be done to decide for the future of this community. In addition, Barredo (2014) stated that Filipino learners experience difficulties in meeting the challenges imposed by rapid global changes hence, affecting the attainment of functional literacy. Based from the students' performance in National Achievement Test, science subject has been considered as the most difficult field of study in the students' basic education level.

Data from the National Statistics Office (NSO) shows that literacy rate among Filipinos increased by five percent (5%) from year 2000 to 2010 (Philippine NSO 2013 Annual Report). Moreover, statistical data also shows that the level of ability to read and write in simple language is also declining (NSO, 2010 Census of Population and Housing, Report No. 2A – Demographic and Housing Characteristics (Non-Sample Variables), April 2013). Results of the National Achievement Test ranging from school year 2004 to 2012 are relatively low making science subject to be still the lowest rating subjects among others (Nicolas-Victorino, 2011).

In order for the learners to acquire and apply scientific and technological knowledge and to help find solutions to scientific issues for the benefit of the community, a positive attitude and interest in responding to science and technology in general should be enhanced including the learning environment (Programme for International Students Assessment (PISA) Survey, 2018).

In the study of Bernardo, Limjap, Prudente and Loreda (2008), it was observed that students' perception in learning science may affect leaners' academic development. Positive attitude in understanding science concepts is a good indicator towards achievement (Aksela & Juntunen, 2013) as well as increased level of students' interest and motivation in learning (Dagdag, Cuizon & Bete, 2019). In the field of chemistry, the result of the study of Aksela and Juntunen (2013) shows that the inquiry-based teaching approaches is effective in boosting interest and sustaining chemistry education. They observed that students should engage themselves in real life observations as to what their chemistry lessons are all about. They also added that chemistry lessons should also be integrated to environmental issues to promote conservation and environmental literacy. Therefore, there is a need to determine the citizen's functional ability with regard to society not only for knowledge but a person responsible to his actions and decisions through using their skills. Hence, the significant role of scientific knowledge and skills should be developed.

As mentioned by Salandanan (2010), the acquisition of knowledge and science process skills development are essential to scientific inquiry. Moreover, the inculcation of values, scientific attitudes, appreciation and critical thinking should be considered in undertaking science education in setting objectives as guides for its instructional level.

With regards to the achievement of the students, the enhanced K to 12 Curriculum emphasizes the accumulation of scientific knowledge through assessing what information is needed, its location and how it will be gathered. Moreover, process skills and making meanings out of the information are also needed in understanding knowledge. These science process skills include basic and integrated skills (Vitti & Torres, 2006 and Wolfinger, 2003). The basic science process skills are the following: (1) Observing- the usage of senses to gather information and related data about an object and events. (2) Inferring- this is to make assumptions based from the generated ideas of gathered ideas and information. (3) Communicating- systematic reporting of data, results and discussions through display and graphic presentation. (4) Classifying- the grouping of objects based on traits and behavior being observed. (5) Measuring- identifying the dimensions and scope of an object or event using standardized or non-standard measures. (6) Predicting- asserting the potential and possible outcome of a future event based on observable configuration of evidences. (7) Questioning- recognizing and asking questions about an object, event or a phenomenon for further investigations.

The following are the integrated science process skills: (1) Controlling variables is being able to determine variables that may affect an outcome of a studied experiment even if the most of the constants are kept while only the independent variable is only manipulated. (2) Defining operationally is stating the process of measuring a variable of an experiment and observation. (3) Formulate hypothesis is to give tentative or partial explanation based on phenomenon, event and experiences which can be tested. (4) Interpreting data through analyzing and drawing conclusions by assessing the gathered data. (5) Experimenting is a process of systematic approach in solving problems through the identification of problem, make a significant hypothesis, determining and controlling variables with its operational definitions, design the experimental procedures, conducting and interpreting the data to give results of the experiment. (6) Formulate models through creating displays either mental or physical models to a process or events.

Teachers should emphasize science process skills through activities that are usually conducted inside the classroom because experiences likely heighten the understanding of the concept being thought (Abungu et al., 2014 and Abdullah, Lebar, & Abd. Shukor, 2018). But in the current view, there is a difficulty in the integration of process skills in learning because of some factors such as availability of materials, time management and acquisition of knowledge between learners and teachers. If teachers has less emphasis on students' science process skills, these will lead to students' low levels of inquiry such as confirmation and structured inquiry (Kahar & Sani, 2018). Another factor is the concept of pseudoscience wherein people certainly believes to ideas and beliefs without certain and valid reason and observation. Pseudoscience may affect rational thinking and open-mindedness to vast array of ideas and realities (Raff, 2013).

Determining the students' knowledge and process skills in learning is essential to cater students' needs and capacities. This will also help teachers to their teaching modalities such as producing learning materials that will aid them to ensure meaningful class discussion.

Research objectives

This study was conducted to determine the students' knowledge and process skills in learning science specifically grade 8-Chemistry. Results of the gathered data will be used as basis in proposing intervention materials to enhance students' academic performance.

Methodology

Research design

This study utilized the descriptive survey method of research. This method involves information about variables and it is employed to measure the existing phenomenon.

Respondents of the study

The population frame of the study was three hundred and thirty two (332) Grade 8 students from seven (7) high schools in the Division of Santiago City, Philippines. The researcher used cluster sampling to select subjects due to the limited time permitted by the heads of the selected high schools. To conduct the study, permission was approved by the division superintendent and high school principals.

Instrumentation

The research instruments used in the study was composed of two parts: multiple choice test items (Part I) and process skills checklist (Part II). The spiral curriculum of K12 program shows that science subjects specifically in the field of Physics, Chemistry, Biology and Environmental Science are taught within four quarters in each school year. For grade 8 science, Chemistry topics were offered during the third quarter.

The researcher together with two science teachers prepared and arranged the multiple choice items for knowledge part. The items were also derived from K to 12 learners and teachers' module for grade 8 science. The multiple choice test items for the knowledge part comprise three general topics in Chemistry-Grade 8 namely: Particle Nature of Matter, Atomic Structure and Periodic Table of Elements. The topics were indicated in the K-12 Grade 8 curriculum by the Department of Education. The multiple choice test items were checked and undergone item analysis through a level of difficulty and discrimination index.

The percentage scores of the items that are greater than 50% are considered as passed while below 50% is measured as failed. The overall percentage scores of the students in a particular lesson in chemistry were interpreted using the K to 12 Level of Proficiency by the Department of Education (DepEd): Beginning (74 % and below); Developing (75% - 79%); Approaching Proficiency (80% - 84%); Proficient (85% - 89%) and Advanced (90% and above).

The Chemistry process skills checklist includes the following science processes such as inferring, questioning, communicating, interpreting, experimenting and formulating models. The checklist measures the students' ability to exercise the application of scientific inquiry process in their chemistry subject. The checklist was adapted from Basilio (2013).

Table 1. Mean and qualitative description for chemistry process skills checklist.

Mean	Qualitative Description
1.00 – 1.75	Negative
1.76 – 2.49	Poor
2.5 – 3.25	Fair
3.26 – 4.00	Positive

Validation and reliability

The research instrument composed of multiple choice test items and process skills checklist was content validated by a group of experts in science education; two head teachers and one master teacher from different National High Schools. The rationale for the validation of the questionnaire was to find out if the instrument would really draw out the responses desired to provide the needed data for this study and to be sure that the statements were clear and free from uncertainties.

The research instruments was content validated using 4 rating scales (1- not relevant, 2- somewhat relevant, 3- quiet relevant and 4- highly relevant). The instrument gained an average content validity index of 0.97 for the multiple choice test items while the process skills checklist got 0.94 average content validity index. The pre-tested instruments were corrected in accordance with the findings and suggestions of experts before they were finalized and reproduced. After the pilot testing, the test items on knowledge part has 0.82

reliability coefficient while the process skills check-list has a reliability coefficient of 0.86. This indicates that the research instruments are reliable.

Data analysis

The gathered data were analyzed using the standard score (z-score) and descriptive statistics. To measure the scientific knowledge and skills of students, the indices being of different units and scales were converted to a standard score using z-scores. The mean of the standardized scores of the two indicators of scientific knowledge and skills were computed from which the visual binning was applied. The technique applied in the binning process is by using a cut-off point at mean using one standard deviation based on scanned cases. A qualitative description was consequently constructed out of the binned indices. Moreover, frequency mean and standard deviation were utilized to describe the scientific knowledge and skills of the respondents.

The Microsoft Excel 2013 and SPSS v. 16 (Statistical Package for the Social Sciences) are used for statistical analyses. The results of the data became the basis of the researcher to propose an intervention material.

Findings and discussion

The following are the results of the gathered data in determining the scientific knowledge and process skills of grade-8 students in chemistry:

Knowledge

Based on Table 2, the 75.83% overall scores of the respondents using the level of proficiency scale from the K to 12 curricula is “Developing Level”. Specifically, the respondents are in the “Developing Level” on general topics on particle nature of matter and periodic table of elements while “Beginning Level” for topics on atomic structure.

Table 2. Mean, standard deviation and qualitative description of the respondents’ scientific knowledge.

General Topics	SD*	%	QD*
Particle Nature of Matter	1.03	78.75%	Developing Level
Atomic Structure	1.00	70.38%	Beginning Level
Periodic Table of Elements	1.00	79.125%	Developing Level
Total Knowledge	1.86	75.83%	Developing Level

** SD- Standard Deviation, QD-Qualitative Description*

It denotes that the knowledge competency of the respondents in these particular areas in chemistry is low. Demir, Kilinc and Dogan (2012) found out that there is a gap between the learning targets of the spiral science curriculum and students’ level cognitive abilities and this made teachers to face difficulty in teaching the wide range of knowledge and number of concepts that grow in complex with the change of grade levels. Consequently, the students were required to study by rote learning and leads to a low level of understanding the practical and theoretical competency of the subject.

Teachers are then challenged to adapt to the demands of the curricular program to the level of understandings and practices of the students by altering and amending instructions, modifying materials, and designing and crafting tasks. It will involve students in process-based learning, and to engage motivational procedures and techniques in increasing the students' confidence, interest, motivation and competence in learning science.

In addition, items in the scientific knowledge with topics regarding atomic theory and model, sub-atomic theory, pure substances and mixtures, and trends in the periodic table got the lowest score from the respondents. These areas were considered by the researcher that needs an intervention material in learning Chemistry-Grade 8.

Chemistry process skills

Chemistry process skill checklist is used to measure the ability of the students to practice the cycle of steps in the scientific inquiry process specifically in their chemistry subject. In the K to 12 curricula, process skills are required to be developed among learners and are integrated into the topics in science regardless of its spiral form. The overall mean of the student's process skills is 2.45 (SD = 0.44) and rated as poor. Based on the result, the students lack some science process skills.

Table 3. Frequency distribution, mean, standard deviation and qualitative description on respondents' chemistry process skills.

Item	Statement	Process Skills	$\overline{X}$	SD*	QD*
1	I can use chemistry knowledge to formulate a question.	Inferring	2.37	.72	Poor
2	I can ask questions that can be answered through data collection.	Questioning	2.50	.82	Fair
3	I can design scientific procedures to answer questions.	Experimenting	2.34	.89	Poor
4	I can communicate scientific procedures to others.	Communicating	2.33	.80	Poor
5	I can record the gathered data accurately.	Measuring	2.50	.84	Fair
6	I can create a graph for presentation to others through using data.	Interpreting	2.68	.83	Fair
7	I can create a display to communicate my data and observations.	Experimenting	2.38	.82	Poor
8	I can analyze the results of chemistry investigations.	Interpreting	2.27	.73	Poor
9	I can use chemistry terms to share my results.	Communicating	2.27	.75	Poor
10	I can explain my results through using models	Formulating models	2.51	.85	Fair
11	I can use the analyzed data of my investigations to answer the queries being asked or I asked.	Interpreting	2.80	.82	Fair
	OVERALL		2.45	.44	Poor

Scale: 1.00-1.75 Negative; 1.76-2.49 Poor; 2.5-3.25 Fair; 3.26-4.00 Positive
** SD- Standard Deviation, QD-Qualitative Description*

Table 3 also shows that items with inferring, experimenting, communicating, measuring and interpreting process skills and their overall chemistry process skills are rated as poor. Science process skills are developed due to the integration of concepts in real life situation particularly engaging students in activities that will likely heighten the students' interest and abilities to improve their cognitive skills towards the subject (Abungu, et al., 2014).

As stated by Salandanan (2010) science process skills should be considered in undertaking science education in setting objectives as guides for its instructional level and teachers need to emphasize the integration of process skills comprehensively in every possible circumstance in the lesson to increase the scientific literacy among students. Hence, making an intervention material, include activities that contain the scientific method which will improve the process skills of the learners.

Z-Scores, skewness and kurtosis of knowledge and process skills

Table 4 shows that the z-scores of the respondents are used to determine the normal distribution of the respondent's scores in knowledge and skills. The overall scores of the respondents in knowledge and skills are positively skewed (0.44), showing that most of the respondents scored low in these areas. On–the other hand, the kurtosis of scientific knowledge part is -0.24 indicating a platykurtic distribution because the low, average, and high scores of the respondents in this area vary greatly to each other. Moreover, the kurtosis of 0.91 of the overall knowledge and process skills of the respondents is a leptokurtic distribution signifying the high probability of extreme values. Therefore, teachers should consider likely factors that affect conceptual knowledge and skills to employ activities suited to a diverse group of learners.

Table 4. Raw and standard scores, skewness and kurtosis distribution of the respondents 'knowledge and process skills.

	Raw Score				Standard Score				Skewness	Kurtosis
	Min	Max	Mean	SD	Min	Max	Mean	SD		
Scientific Knowledge	2	12	6.25	1.85	-2.29	3.10	0.00	1.00	0.09	-0.24
Chemistry Process Skills	1.27	4.00	2.45	0.44	-2.66	3.50	0.00	1.00	0.47	0.91
Scientific Knowledge and Skills					-2.27	2.76	0.00	0.77	0.44	0.91

Overall knowledge and process skills

To measure the student-respondents scientific knowledge and skills, the indices were converted to a standard score using z-scores, and a qualitative description was constructed from the binned indices. Therefore, the frequency and distribution of the respondent's scientific knowledge and skills were classified.

Based on Table 5, 35.8 % of the respondents are partially proficient in their knowledge and process skills with z-scores ranging from -0.76 to 0.00 while only 14.2 % of the respondents are in the advanced proficient level with z-scores of 0.78 and above. There are also 15.7 % of respondents in the 'not proficient' degree and 34. 3% of the respondent's population is in the 'proficient' level.

It can be deduced that most of the respondents are partially proficient in their knowledge and process skills. The low acquisition of knowledge and skills of the respondents signifies that there are still gaps behind the ideal target of the desired level of proficiency towards learning chemistry. There should be actions to be undertaken such as determining the learning difficulty of the students due to inadequate background in knowledge and skills and for the teachers to identify and pre-assess their learners' background knowledge and skills, provide practice and instructional scaffolding such as making learning materials and opportunities to practice the concept they have learned through the integration of real-life situations.

Table 5. Frequency and Percent Distribution of Knowledge and Process Skills of the Respondents

Classification	*z*-scores	F	%
Not Proficient	-0.77 and below	52	15.7
Partially Proficient	-0.76 - 0.00	119	35.8
Proficient	0.01 - 0.77	114	34.3
Advanced Proficient	0.78 and above	47	14.2
	Total	332	100.0

Areas in chemistry that needs an intervention material.

In the K to 12 curricula, chemistry of grade 8 science is divided into three main topics namely, particle nature of matter (with sub-topics of atomic theory and models and sub-atomic particles), Atomic structure (with sub-topics of pure substances and mixtures and atoms and molecules) and Periodic Table of Elements (with sub-topics such as trends, reading and use of periodic table). In the knowledge part, these topics were assessed using multiple choice items. Based from the results, most of the respondents failed to answer details regarding atomic structure. They also failed in answering questions on trends in the periodic table and pure substances and mixtures.

Since, strategic intervention material is proven to affect the students' academic achievement (Aranes et al. 2014; Gultiana, 2012), the researcher proposed an intervention material with regard to specific topics in chemistry such as atomic theory and model, sub-atomic particles, pure substances and mixtures and trends in the periodic table in order to help students to have a better background in the topic and to enhance their knowledge in terms of chemistry concepts. Moreover, the previous data also shows that students have poor chemistry process skills. Therefore, in proposing an intervention material, the integration of process skills should be considered. The format used is based on the study of Aranes et al. (2014) and Gultiana (2012).

Conclusions and recommendations

As revealed in the study, the knowledge and process skills of the respondents are at par in the ideal target level of proficiency, and they are not comprehensively exposed to the scientific inquiry processes. Moreover, there are areas in chemistry that should be improved. With this, the proposed strategic intervention materials (SIM) are based on the areas in chemistry that are least mastered by the respondents. The proposed intervention material will be subjected to validation and improvement and can be used to another similar study for the enhancement of teaching chemistry- grade 8.

Moreover, students are encouraged to participate in different chemistry activities such as joining science fairs, seminars, and science organizations to practice their process skills and improve their knowledge level. Teachers should elevate their teaching styles in teaching chemistry concepts and emphasized the application of process skills that are related to their daily life activities. Therefore, the results of studies in teaching sciences are significant as platform in reviewing and assessing science curriculum for further improvements.

Acknowledgement

The author would like to thank the participation of the selected public high schools of the Department of Education, Division of Santiago City, Philippines. The author also would like to express her appreciation to the graduate school of Philippine Normal University- North Luzon Campus for the guidance and constructive analysis of the result of the study.

References

Abdullah, E., Lebar, O., & Abd. Shukor, A. (2018). The effects of performance-based assessment to enhance teaching and learning science (ForPS) model on science process skills and science concepts understanding of secondary students in Kinta District of Perak. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, *2*(2), 24-34.

Abungu, H., Okere, M., & Wachanga, S. (2014). The effect of science process skills teaching approach on secondary school students' achievement in chemistry in Nyando District, Kenya. *Journal of Educational and Social Research*, *4*(6), 1-4. doi: 10.5901/jesr.2014.v4n6p359

Aksela, M. & Juntunen, M. (2013). Life-cycle thinking in inquiry-based sustainability education – Effects on students' sttitudes towards chemistry and environmental literacy. Retrieved from http://www.cepsj.si/pdfs/cepsj_3_2/cepsj_pp157-180_juntunen.pdf

Aranes, F., Espinosa, A. & Salviejo, E. (2014). Strategic intervention material-based instruction, learning approach, and students' performance in chemistry. *International Journal of Learning, Teaching, and Educational Research*, *2*(1), 91-123.

Barredo, K. (2014). Development on academic performance in science using strategic intervention material. Retrieved from http://www.classroom20.com/profiles/blogs/strategic-intervention-materials-in-science

Basilio, T. (2013). *Science conceptual learning and constraints among selected grade 7 students of Solano High School* (Unpublished Graduate Thesis). Philippine Normal University- North Luzon Campus, Alicia, Isabela.

Bernardo, A., Limjap, A., Prudente, M., & Loreda, L. (2008). Students' perceptions of science classes in the Philippines. *Asia Pacific Education Review by Education Research Institute 2008*, 9(3).

Cabili, M., Sequete, F., & Capilitan, D. (2015). A review on the issues in the implementation of K+12 science curriculum: A baseline study 2015. Retrieved from https://www.researchgate.net/publication/308019509

Dagdag, J. D., Cuizon, H. G., & Bete, A. O. (2019). College students' problems and their link to academic performance: Basis for needs-driven student programs. *Journal of Research, Policy & Practice of Teachers and Teacher Education*, *9*(2), 54-65.

Demir, S. Kilinc, M., & Dogan, A. (2012). The effect of curriculum for developing efficient studying skills on academic achievements and studying skills of learners. *International Electronic Journal of Elementary Education*, *4*(3), 427-440.

Gregorio, J. (2012). *Module 6: Science education in the Philippine society-lesson 13: Scientific literacy* (A Presentation). Retrieved from http://scienceeducationinthephilippines.blogspot.com/

Gultiana, A. (2012). Effects of strategic intervention materials (SIM) on academic achievement in the chemistry of public high school students. Retrieved from http://www.slideshare.net/neoyen/strategic-intervention-material

Department of Education. (n.d.). K to 12 curriculum guide and conceptual framework. Retrieved from https://www.officialgazette.gov.ph/k-12/

Kahar, N. D., & Sani, S. S. (2018). Science process skills acquisition level among form two students in one district of Sabah. *Journal of Research, Policy & Practice of Teachers and Teacher Education, 8*(1), 32-44.

Lillard, A., Lerner, M., Hopkins, E., Dore, R., Smith, E. & Palmquist, C. (2013). The impact of pretend play on children's development: A review of the evidence. *American Psychological Association 2013, 139*(1), 1–34.

Mokyr, J. 2018. Building Taller Ladders. *Finance & Development, 55*(2), 1-4.

Montebon, D. (2014). K12 science program in the Philippines: Student perception on its implementation. *International Journal of Education, 2*(12), 1-12.

Movahedzadeh, F. (2011). Improving students' attitude toward science through blended learning. *Science Education and Civic Engagement*, 3(2), 13-19.

Murphy, C. (2005). Primary science in the UK: A scoping study final report to the welcome trust. Retrieved from http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtx026636.pdf

National Statistics Office. (2013). 2010 Census of population and housing, report no. 2A – Demographic and housing characteristics (non-sample variables). Retrieved from https://psa.gov.ph/sites/default/files/SULU_FINAL%20PDF.pdf

National Statistics Office. (n.d.). 2013 Annual Report. Retrieved from https://psa.gov.ph/sites/default/files/2013%20NSO%20Annual%20Report_0.pdf

Nicolas-Victorino, A. (2011). *Factors affecting the national achievement test of selected second year high school students in Santa Maria, Bulacan* (Unpublished Master's thesis). Open University of the Polytechnic University of the Philippines, Manila, Philippines. Retrieved from https://www.academia.edu/2028201/Factors_affecting_the_National_Achievement_Test_performance_of_selected_second_year_high_school_students_in_Santa_Maria_Bulacan

Ogunkola, B. (2013). Scientific literacy: Conceptual overview, importance and strategies for improvement. Retrieved from http://search.proquest.com/pqcentral/docview/1399981570/395313D50DD34910PQ/1?accountid=141440#

Oluwatelure, T. (2010). Classroom environment as a correlates to scientific literacy. *Journal of College and Learning (TLC), 7*(6), 1-10.

Programme for International Students Assessment (PISA) 2015 Results in Focus. (2018). Retrieved from https://www.oecd.org/pisa/pisa-2015-results-in-focus.pdf

Raff, J. (2013). How to read and understand a scientific paper: A guide for non-scientists. Retrieved from http://violentmetaphors.com/2013/08/25/how-to-read-and-understand-a-scientific-paper-2/

Roseman, J. E., Herrmann-Abell, C. F., & Koppal, M. (2017). Designing for the next generation science standards: Educative curriculum materials and measures of teacher knowledge. *Journal of Science Teacher Education, 28*(1), 111-141.

Salandanan, G. (2010). *21st Century science and health 5*. Quezon City: Pheonix Publishing House.

Sirhan, G. (2011). Learning difficulties in chemistry: An overview. *Journal of Turkish Science Education, 4*(2), 2-20.

The ASEAN Secretariat Jakarta. (2016). ASEAN documents series 2015. Retrieved from https://asean.org/storage/2016/10/ASEAN-Documents-Series-2015.pdf

Vitti, D. & Torres, A. (2006). Practicing science process skills at home a handbook for parents. Retrieved from http://www.nsta.org/elementaryschool/connections/200712TorresHandoutParentNSTAConn.pdf

Wolfinger, D. (2003). *Science in the elementary and middle school.* United States: Addison Wesley Longman, Inc.