Competencies and Readiness of Science Teachers: Implications to the Implementation of the Grade 10 of the K to 12 Basic Education Curriculums

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Abstract

This descriptive study investigated the competencies of six hundred and ten (610) teacher trainees from eight DepEd Divisions: Iloilo Province, Iloilo City, Guimaras, Passi City, Roxas City, Aklan, and Antique before and after a week-long live-in training and their readiness to implement Grade 10 Science. Teachers were trained on content subjects such as Earth and Space; Force, Motion and Energy; Matter; and Living Things and their environment; K -12 Updates, Pedagogy and Assessment. Data representing teachers' competencies showed average competencies both in Force, Motion and Energy and in the Overall Content of the Program and low in Earth and Space; Living Things and their Environment; and in Matter before the training. After the training, this was also elevated to the average level with a slight increase in the mean scores in each area. The adequate increase in teachers' competencies is confirmed by their substantial learning on various approaches and strategies in teaching especially on contextualization, localization or indigenization, and differentiated instruction; Science content and 21st Century skills; and the Goals, Features and Updates of the K to 12 Curriculum. These outcomes seem to suggest that the training was able to accomplish its desired goals and objectives. Teachers also gave the impression that they were likewise ready to implement Grade 10 Science. Accompanying this are their perceived challenges especially their lack of mastery of the content especially for the specialists and the perennial problem on scarcity of teaching and learning materials such as books, laboratory chemicals, and equipment. To these trepidations it is recommended that a follow-up intensive upgrading training both on content subjects and pedagogy be provided by the Department of Education for a longer period especially for non-major teachers. In addition, teachers can also work collaboratively to write lesson

exemplars using strategies and assessment tools that can enhance students' learning and appreciation of science. These outputs can also be tried out in time in the field under supervision. It is also suggested that the Department of Education may include as part of their agenda, the monitoring and evaluation of the different trainings which were implemented focusing on the K to 12 Science Curriculum. This can assess whether, the program have addressed constructively the educational needs in the province.

Keywords: competencies, readiness, grade 10 science of k to 12, basic education curriculum

Nelson Rolihlahla Mandela once said, "Education is the most powerful weapon which can be used to change the world." For the Filipino people the K to 12 Curriculum or Republic Act No. 10533, otherwise known as the "Enhanced Basic Education Act of 2013", was an affirmation to this idea. President Aquino signed this into law on May 15, 2013 which consequently formalized the K to 12 basic education program (Lim, D.G, 2014). From the former 10-year basic education curriculum, the K to 12 program mandates 1 year of kindergarten and 12 years of basic education, comprising of 6 years of primary education, 4 years of junior high and 2 years of senior high school. The relevant features of RA 10533 strive to: (a) strengthen early childhood education; (b) build proficiency through language; and (c) provide specialized upper secondary education RA 10533 seeks to: (a) strengthen early childhood education; (b) build proficiency through language; and (c) provide specialized upper secondary education (Philippine Official Gazette, n.d.)

As envisioned, graduates of the K to 12 Curriculum will be able to acquire mastery of the basic competencies as prescribed in the Basic Education Program. They will be emotionally mature, socially aware, and proactive when they involve themselves in both public and civic concerns. At 2018, the first Senior High School (SHS) graduates, will be more adequately equipped for work, entrepreneurship, or higher education. Being at the right age, they can now be legally employed to earn better and at the same time universally competitive with graduates from other countries. They will become empowered and learned individual through a Program that is engrained on sound educational values and principles geared towards excellence. Such empowerment will enable them to coexist in fruitful harmony with local and global communities (Department of Education Discussion Paper, 2010).

Here in Region VI, to equip teachers with the pedagogy, content, and skills required to teach Grade 10 Science, the Department of Education held a mass training for Grade 10 Science teachers on May 18-23, 2015. This big task aimed to improve the teachers' understanding of what Grade 10 Science of the K to 12 is all about. More importantly it intended to develop their competence and readiness in implementing the curriculum for the coming school year 2015-2016.

This research was conducted in order to determine the competencies and readiness of teachers in the implementation of the Grade 10 Science of the K-12 Basic Education Curriculum.

The K to 12 Curriculum

K to 12 Curriculum Program covers 13 years of basic education with the following key stages: Kindergarten to Grade 3; Grades 4 to 6; Grades 7 to 10 – the Junior High School; and Grades 11 and 12 – the Senior High School (DepEd, 2017).The Kindergarten are the 5-year old cohort that takes a standardized kinder curriculum. Elementary education refers to primary schooling that involves six or seven years of education. Secondary Education refers to high school (Cruz, 2010).

Every Filipino has a right to free and worthy education, and this is made possible through the Kindergarten and 12 years of quality basic education provided by the government. Learners who go through the 12 years- cycle will get an elementary diploma after 6 years, a junior high school diploma after 4 years, and a senior high school diploma after 2 years. A full twelve (12) years of basic education is required for entry into tertiary level education. The college freshmen entered last school year 2018-2019.

Learners in Senior High School experience two years of in-depth specialization depending on the occupation or career track they wish to pursue. However, they need to consider too the skills and competencies relevant to the job market. These two years intend to provide time for them to consolidate their acquired academic skills and capabilities to prepare them for their future career. Thus, the curriculum allowed specialization in Science and Technology, Music and Arts, Agriculture and Fisheries, Sports, Business and Entrepreneurship.

The Implementation Plan. K to 12 implementation of the Department of Education (DepEd) went through several stages: (1) the offering of the Universal Kindergarten last SY 2011-2012; (2) the unclogging of the Basic Education Curriculum in SY 2012-2013; (3) the Enhanced 12-year Curriculum implementation which started with the incoming Grade 1 students last SY 2012-2013; (4) the incoming freshmen of SY the 2012-2013 were the first beneficiary of a free Senior High School education which will be made available by DepEd in public schools for SY 2016-2017; and (5) the electives in Arts, Music, Technical-Vocational, and others to be offered in Senior High School.

DepEd took into account the issues and concerns of all stakeholders, including the high school graduates before 2016 when it implemented the

K- to 12 curriculum. Regional consultations with stakeholders from the industry, university, scientists, parents, teachers, school administrators, community leaders, media, students, and many others began early in 2011. The mechanics and other details of the transition plan were further threshed out with Higher Education Institutes in coordination with the Commission of Higher Education (CHED), Technical Education and skills Development Authority (TESDA), and other critical stakeholders. Adding two more years in the curriculum is projected to decongest and enhance the basic education curriculum and provide better quality education for all.

The Enhanced K to 12 Basic Education program aimed to create a functional basic education system that will produce productive and responsible citizens equipped with the essential competencies and skills for life-long learning and employment. This will enrich the basic education system to full functionality to fulfill the learners' basic learning needs. This is consistent with President Benigno Aquino's agenda on using quality education as a long-term solution to poverty.

The Grade 10 Science Curriculum

Science is important to everyone. Thus, school science education should support the development of scientific literacy in all students. Moreover it has to motivate them to pursue careers in science, technology, and engineering (DOST-SEI & UPNISMED, 2011). Through science education, learners can become more informed and participative citizens who are able to make judgments and decisions regarding applications of scientific knowledge that may have social, health, or environmental impacts.

Science's primary goal is to understand the natural and human-designed worlds. It refers to certain processes used by humans for obtaining knowledge about nature and to an organized body of knowledge about nature obtained by these processes. It is a dynamic and creative activity with a long and interesting history. Scientists continuously assess and judge the soundness of scientific knowledge claims by testing laws and theories, and modifying them in light of compelling new evidence or a re-conceptualization of existing evidence (SCCAO and STAO/APSO, 2006, pp. 1–2)

Both science content and science processes are intertwined in the K to 12 science curriculum. Without the content, learners will have difficulty utilizing science process skills since these processes are best learned in context. Organizing the curriculum around situations and problems that challenge and arouse students' curiosity motivates them to learn and appreciate science as relevant and useful. Rather than relying solely on textbooks, varied hands-on, minds-on, and hearts-on activities will be used to develop students' interest and let them become active learners. The K to 12 science curriculum as a whole, is learner-centered and inquiry-based which emphasizes the use of evidence in constructing explanations. Concepts and skills in Life Sciences (Living Things and their Environment), Physics (Force, Motion, and Energy), Chemistry (Matter), and Earth Sciences (Earth and Space) are presented with increasing levels of complexity from one grade level to another in a spiral progression. This paves the way to a deeper understanding of science concepts. In the K to 12 Science Curriculum, the concepts and skills are integrated rather than discipline-based, as shown in Table 1 and Table 2. It stresses the connections across science topics and other disciplines as well as applications of concepts and thinking skills to real life situations (Ocampo, D. 2012, 2013).

Table 1

The Science Standards of Learning Curriculum Framework for Grade 10

CORE LEARNING AREA STANDARD	KEY STAGE STANDARDS	GRADE-LEVEL STANDARDS
• The learners demonstrate understanding of basic science concepts and application of science-inquiry skills. They exhibit scientific attitudes and values to solve problems critically, innovate beneficial products, protect the environment and conserve resources, enhance the integrity and wellness of people, make informed decisions, and engage in discussions of relevant issues that involve science, technology, and environment.	• At the end of Grade 10, the learners should have developed scientific, technological, and environmental literacy and can make that would lead to rational choices on issues confronting them. Having been exposed to scientific investigations related to real life, they should recognize that the central feature of an investigation is that if one variable is changed (while controlling all others), the effect of the change on another variable can be measured. The context of the investigation can be problems at the local or national level to allow them to communicate with learners in other parts of the Philippines or even from other countries using appropriate technology. • The learners should demonstrate an understanding of science concepts and apply science inquiry skills in addressing real-world problems through scientific investigations.	• At the end of Grade 10, learners realize that volcanoes and earthquakes occur in the same places in the world and that these are related to plate boundaries. They can demonstrate ways to ensure safety and reduce damage during earthquakes, tsunamis, and volcanic eruptions. Learners can explain the factors affecting the balance and stability of an object to help them practice appropriate positions and movements to achieve efficiency and safety such as in sports and dancing. They can analyze situations in which energy is harnessed for human use whereby heat is released, affecting the physical and biological components of the environment. Learners will have completed the study of the entire organism with their deeper study of the excretory and reproductive systems. They can explain in greater detail how genetic information is passed from parents to offspring, and how diversity of species increases the probability of adaptation and survival in changing environments. Learners can explain the importance of controlling the conditions under which a chemical reaction occurs.

		They recognize that cells and tissues of the human body are made up of water, a few kinds of ions, and biomolecules. These biomolecules may also be found in the food they eat.

Table 2

The Content Standards, Performance Standards and Competencies for Grade 10 science

CONTENT	CONTENT STANDARDS	PERFORMANCE STANDARDS	COMPETENCIES
EARTH SPACE 1. Plate Tectonics 1.1 Distribution 1.1.1 Volcanoes 1.1.2 Earthquake epicenters 1.1.3 Mountains ranges 1.2 Plate Boundaries 1.3 Processes and landforms along plate boundaries 1.4 Internal Structure of the Earth 1.5 Mechanism (possible causes of the movement) 1.6 Evidence of plate movement	The Learners demonstrate an understanding of: • the relationship among the locations of volcanoes, earthquake epicenters, and mountain ranges	The Learners shall be able to: • demonstrate ways to ensure disaster preparedness during earthquakes, tsunamis, and volcanic eruptions • suggest ways by which he/she can contribute to government efforts in reducing damage due to earthquakes, tsunamis, and volcanic eruptions	The Learners should be able to: • describe the distribution of active volcanoes, earthquake epicenters, and major mountain belts; • describe the different types of plate boundaries; • explain the different processes that occur along the plate boundaries; • describe the internal structure of the Earth; • describe the possible causes of plate movement; and • enumerate the lines of evidence that support plate movement

FORCE, MOTION AND, ENERGY 1. Electromagnetic Spectrum	The Learners demonstrate an understanding of: • the different regions of the electromagnetic spectrum		The Learners should be able to: • compare the relative wavelengths of different forms of electromagnetic waves; • cite examples of practical applications of the different religions of EM waves, such as the use of radio waves in telecommunications; • explain the effects of EM radiation on living things and the environments;
2. Light 2.1 Reflection of Light in Mirrors 2.2 Refraction of Light in Lenses	• the relationship between electricity and magnetism in electric motors and generators		• predict the qualitative characteristics (orientation, type, and magnification) of images formed by plane and curved mirrors and lenses; • apply ray diagramming techniques in describing the characteristics and positions of images formed by lenses; • identify ways in which the properties of mirrors and lenses determine their use in optical instruments (e.g., cameras and binoculars);

			• demonstrate the generation of electricity by movement of a magnet through a coil; and • explain the operation of simple electric motor and generator
LIVING THINGS AND THEIR ENVIRONMENT 1. Coordinated Functions of the reproductive, Endocrine, and Nervous System 2. Heredity: Inheritance and Variation	The Learners demonstrate an understanding of: • organisms as having feedback mechanisms, which are coordinated by the nervous and endocrine systems • how these feedback mechanisms help the organism maintain homeostasis to reproduce and survive • the information stored in DNA as being used to make proteins • how changes in a DNA molecule may cause changes in its product • mutations that occur in sex cells as being heritable	The Learners should be able to: • write an essay on the importance of adaptation as a mechanism for the survival of a species	The Learners should be able to: • describe the parts of the reproductive system and their functions; • explain the roles of hormones involved in the female and male reproductive systems; • describe the feedback mechanism involved in regulating processes in the female reproductive system (e.g., menstrual cycle); • describe how the nervous system coordinates and regulates these feedback mechanisms to maintain homeostasis; • explain how protein is made using information from DNA; • explain how mutations may cause changes in the structure and function of a protein; • explain how fossil records, comparative anatomy, and genetic information provide evidence for evolution;

4. Ecosystems 4.1 Flow of the Energy and Matter in Ecosystems 4.2 Biodiversity and Stability 4.3 Population Growth and Carrying Capacity	• how evolution through natural selection can result in biodiversity • the influence of biodiversity on the stability of ecosystems • an ecosystem as being capable of supporting a limited number of organisms		• explain the occurrence of evolution; • explains how species diversity increases the probability of adaptation and survival of organisms in changing environments; • explain the relationship between population growth and carrying capacity; and • suggest ways to minimize human impact on the environment.
MATTER 1. Gas Laws 1.1 Kinetic Molecular Theory 1.2 Volume, pressure, and temperature relationship 1.3 Ideal gas law 2. Biomolecules 2.1 Elements present in biomolecules 2.2 Carbohydrates, lipids, proteins, and nucleic acids 2.2.1 Food Labels 3. Chemical Reactions	The Learner should demonstrate an understanding of… • how gasses behave based on the motion and relative distances between gas particles • the structure of biomolecules, which are made up mostly of a limited number of elements, such as carbon, hydrogen, oxygen, and nitrogen	• using any form of media, present chemical	Investigate the relationship between: • volume and pressure at constant temperature of a gas; • volume and temperature of a gas; • explains these relationships using the kinetic molecular theory; • recognize the major categories of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids; apply the principles of conservation of mass to chemical reactions; and

	• the chemical reactions associated with biological and industrial processes affecting life and the environment	reactions involved in biological and industrial processes affecting life and the environment	• explain how the factors affecting rates of chemical reactions are applied in food preservations and materials production, control of fire, pollution, and corrosion.

The Problem

This study looked into the competencies of the Grade 10 Science teachers and their readiness to implement the Grade 10 Basic Education Curriculum in Science. Specifically, the study sought answers to the following questions:

1. What level of competencies do Grade 10 Science teachers have prior to attending the training?
2. Is there a significant increase in the competencies of the Grade 10 Science teachers after the training?
3. To what extent are the Grade 10 teachers ready to implement the Grade 10 Science of the K to 12 Basic Education Curriculum?
4. What challenges do Grade 10 teachers expect when they implement the Grade 10 Science of the K to 12 Basic Education Curriculum?

Methodology

This descriptive study made use of both quantitative and qualitative data. The participants included all 1, 443 Grade 10 Science teacher trainees from eight DepEd Divisions: Iloilo Province, Iloilo City, Guimaras, Passi City, Roxas City, Aklan, Antique and Capiz.

To gather the necessary information, three instruments were utilized: the Registration form, the Rapid Assessment form, and the End of Training Assessment form. The Rapid Assessment Form was adapted from F3 - M&E Form 5 of DepEd TEC while the End of Training Assessment Form was adapted from F3 - M&E Form 3 of the DepEd TEC. The revised versions have gone through face and content validation by three experts on evaluation. The reliability coefficient of the Rapid assessment Form and the End of Training

Assessment Form were also established. The registration form provided the data for the profile of the participants. The Rapid Assessment form afforded

the competencies of the Grade 10 teachers prior to the training and how they were enhanced after. The extent of readiness of the Science teachers were also made available from the accomplished End of Training Assessment form.

Means were used to report the competencies and readiness of the Grade 10 teachers. Standard deviations were used to describe the homogeneity or heterogeneity of the teachers' responses. The t-test for related samples was used to test if there is a significant increase in the competencies of teachers after attending the training.

The competencies of the teachers to implement the Grade 10 of the K to 12 Basic Education Curriculum were interpreted using the following scales.

3.51 - 4.0	**High**	The teacher has mastery of the competencies and have demonstrated or applied them
2.51 – 3.50	**Average**	The teacher has adequate competencies but need to practice them
1.51– 2.50	**Low**	The teacher has inadequate competencies and has no understanding of how to apply them
1.0 – 1.50	**Very Low**	The teacher has no competencies/ learning at all

The readiness of teachers to implement the Grade 10 of the K to 12 Basic Education Curriculum was interpreted using the following scales.

3.51 – 4.0	**Very Ready**
2.51 – 3.50	**Ready**
1.51 – 2.50	**Moderately Ready**
1.0 – 1.50	**Not Ready**

Results and Discussion

This part begins with the perception of Grade 10 teachers regarding the level of their competencies before and after their training. This is followed by an analysis of the different testimonies regarding teachers' most significant learning from their experiences. These impressions in statements made reasonable explanations why significant differences existed in the teachers' competencies before and after attending the training. The discussion looked also at the readiness of teachers to teach soon after the training and eventually their expected challenges while applying what they have learned.

Competencies of Grade 10 Teachers Prior to and After Attending the Training

The pretest and posttest given before and after the training measured only a subdivision of competencies associated with the standards. In this study, competency refers to a description of a particular mental ability or skill teachers are expected to learn during the K to 12 training. Moreover, competency refers to a set of mental abilities and skills teachers must acquire to meet the K to 12 curriculum standards set within a particular domain at a particular level.

This study focused only on Grade 10 Science benchmarks, which are grouped within the given set of competencies across five content areas: (1) Overall content of the program; (2) K to 12 Special Topics; Earth and space; Force, Motion and Energy; Living Things and their Environment; and Matter.

The data in Table 3 shows that Science teachers at the onset of the training perceived themselves to have average competencies both in Force, Motion and Energy (M =2.56, SD =.57) and in the Overall Content of the Program (M =2.54, SD =.46) which included K to 12 Program Updates, Challenges to the K to 12 Program, Insights on Ways to Advocate the K to 12 Program, and Key features of Grade 10 Science. This indicates that teachers have adequate competencies at these two areas but there is still a need to practice the competencies. In addition, most teacher trainees who are teaching in this grade level, equivalent to fourth year in the previous BEC curriculum, are handling Physics which now is Force, Motion and Energy; hence, precious knowledge would explain their average competencies. On the other hand they have low competencies in K to 12 Special Topics (*M* =2.84, *SD* =.54); Earth and Space (*M* =2.32, *SD* =.58); Living Things and their Environment (*M* =2.24, *SD* =.66); and in Matter (*M* =2.37, *SD* =.66). This implies that they have inadequate competencies in the areas mentioned and have little understanding of the concepts in these fields before the training.

Considering the effect of the K to 12 Science training, the teachers appraised themselves as having average competencies with regard to the Overall Content of the Program (*M* =3.26, *SD* =.42), K to 12 Special Topics (*M* =3.32, *SD* =.43); Earth and Space (*M* =3.31, *SD* =.44); Force, Motion, and Energy (*M* =3.22, *SD* =.40), Living Things and their Environment (*M* =3.16, *SD* =.47); and in Matter (*M* =3.22, *SD* =.40). However, it is noticeable that there wasthe slight increase in the mean scores in each area. While teachers

have adequate set of mental abilities and skills acquired during the training, it is essential for them to practice or apply these abilities and skills in the teaching learning situations in every situation as much as possible, so they have that feel of proficiency. In effect, the results also indicate that the teacher training was able to deliver the desired objectives for Grade 10 Science.

Table 3

Level of Competencies of Grade 10 Science Teachers Prior to and after Attending the Training

				Pre			Post
Competencies	N (610)	SD	Mean	Description	SD	Mean	Description
Gain understanding on the updates of the K to 12 program		.57	2.67	Average	.49	3.26	Average
Discuss challenges related to the K to 12 program		.56	2.57	Average	.47	3.22	Average
Share insights on ways to advocate the K to 12 program and among the different stakeholders in the community		.57	2.56	Average	.50	3.25	Average
Identifies key features of Grade 10 Science		.67	2.35	Low	.52	3.30	Average
Overall Content of the Program		.46	2.54	Average	.42	3.26	Average
Gain functional and operational understanding of localization and contextualization in the learning area		.62	2.50	Low	.52	3.35	Average
Identify ways on how the curriculum may be localized and contextualized in their learning area		.61	2.43	Low	.52	3.30	Average

Value the importance of adapting to the learners diversity through localization and contextualization in their learning area	.65	2.54	Average	.52	3.34	Average
Describe the 21st century skills	.61	2.54	Average	.54	3.36	Average
Identify ways to develop the 21st century skills	.61	2.45	Low	.51	3.28	Average
Discuss various strategies on how to apply the 21st century skills to improve teaching and learning	1.38	2.43	Low	.50	3.20	Average
Session 1-K to 12 Special Topics	.54	2.48	Low	.43	3.31	Average
Describe the distribution of active volcanoes, earthquake epicenters, and major mountain belts	.65	2.41	Low	.49	3.26	Average
Describe the different types of plate boundaries	.66	2.25	Low	.53	3.27	Average
Explain the different processes that occur along plate boundaries	.62	2.22	Low	.50	3.21	Average
Describe the internal structure of Earth	.69	2.47	Low	.51	3.26	Average
Describe the possible causes of plate movement	.67	2.35	Low	.52	3.25	Average
Enumerate the lines of evidence that support the plate movement	.63	2.20	Low	.50	3.16	Average
Session 2-Earth and Space	.58	2.32	Low	.44	3.31	Average

Demonstrate the generation of electricity by movement of a magnet through the coil	.67	2.58	Average	.51	3.21	Average
Explain the operation of a simple electric motor and generator	.70	2.60	Average	.52	3.22	Average
Compare the relative wavelengths of different forms of electromagnetic radiation	.71	2.65	Average	.52	3.30	Average
Explain uses of the different forms of EM radiation	.68	2.56	Average	.50	3.25	Average
Create models on how materials react to EM radiation other than light	.66	2.33	Low	.48	3.11	Average
Explain the effects of EM radiation to living things	.70	2.61	Average	.49	3.22	Average
Predict the qualitative characteristics of images formed by plane and curved mirrors and lenses	.71	2.66	Average	.53	3.24	Average
Apply ray diagramming techniques in describing the characteristics and positions of images formed by lenses	.74	2.59	Average	.54	3.20	Average
Identify ways in which the properties of mirrors and lenses determine their use in optical instruments	.74	2.49	Low	.50	3.21	Average
Session 3-Force, Motion and Energy	.57	2.56	Average	.40	3.22	Average

Describe how the nervous system coordinates and regulates these feedback mechanisms to maintain homeostasis	.75	2.30	Low	.55	3.23	Average
Explain how protein is made using information from DNA	.71	2.17	Low	.56	3.17	Average
Explain how fossil records, comparative anatomy and genetic information provide evidence for evolution	.69	2.17	Low	.52	3.10	Average
Explain the occurrence of evolution	.72	2.28	Low	.53	3.13	Average
Explain how species diversity increases the probability of adaptation and survival of organisms in changing environment	.75	2.29	Low	.53	3.19	Average
Session 4-Living Things and their Environment	.66	2.24	Low	.47	3.16	Average

Investigate the relationship between volume and temperature at constant pressure of a gas	.76	2.55	Average	.54	3.41	Average
Explain the relationship between the volume and temperature at constant pressure of a gas using the Kinetic Molecular Theory	.75	2.44	Low	.52	3.29	Average
Recognize the major categories of biomolecules such as carbohydrates and proteins	.69	2.18	Low	.50	3.17	Average
Apply the principles of conservation of mass to chemical reactions	.74	2.30	Low	.50	3.30	Average
Session 5-Matter	.66	2.37	Low	.44	3.29	Average

Note: 3.51 – 4.00 High; 2.51 – 3.50 Average; 1.51 – 2.50 Low; and 1.00 – 1.50 Very Low

Differences in the Competencies of Grade 10 Science Teachers Prior to and After Attending the training

The significance of the difference in the competencies between the pre-post Program Assessment of the teachers was determined using *t*-test for related samples. Table 4 shows the results. It would appear from the data that science teachers believe that training have contributed to their competencies to implement Grade 10 science. The *t*- test yielded a significant difference in the pre-test and post-test results on the competencies of teachers for the five areas: Overall Content of the Program (t =0.000 < 0.05), K to 12 Special Topics (t = 0.000 < 0.05), Earth and Space (t = 0.000 < 0.05), Force, Motion and Energy (t = 0.000 < 0.05), Living Things and Their Environment (t = 0.000 < 0.05), and Matter (t = 0.000 < 0.05). This further means that the implementation of the K to 12 Training for Grade 10 Science teachers have contributed to the increase of teachers' competencies in the five areas mentioned. Perhaps the teachers have learned concepts, skills, and attitudes as embodied in the competencies in the course of the training.

Table 4

Differences in the Competencies of Grade 10 Science Teachers According to Content

Competencies	Mean (Pretest)	Mean (Post test)	Mean Difference	95% Confidence Interval Of the Difference		*t*	df	Sig.
				Lower	Upper			
Gain understanding on the updates of the K to 12 program	2.67	3.26	-.58	-.64	-.527	-20.26*	609	.000
Discuss challenges related to the K to 12 program	2.57	3.22	-.65	-.71	-.595	-23.03*	609	.000
Share insights on ways to advocate the K to 12 program and among the different stakeholders in the community	2.56	3.25	-.69	-.75	-.636	-24.51*	609	.000
Identifies key features of Grade 10 Science	2.35	3.30	-.95	-1.01	-.881	-28.57*	609	.000
Overall Content of the Program	2.54	3.26	-.72	-.76	-.67	-30.90*	609	.000
Gain functional and operational understanding of localization and contextualization in the learning area	2.50	3.35	-.85	-.91	-.785	-26.75*	609	.000
Identify ways on how the curriculum may be localized and contextualized in their learning area	2.43	3.30	-.88	-.94	-.816	-28.37*	608	.000
Value the importance of adapting to the learners diversity through localization and contextualization in their learning area	2.54	3.34	-.80	-.87	-.739	-24.97*	609	.000

Describe the 21st century skills	2.54	3.36	-.83	-.89	-.764	-25.99*	609	.000
Competencies	Mean (Pretest)	Mean (Post test)	Mean Difference	95% Confidence Interval Of the Difference		*t*	df	Sig.
				Lower	Upper			
Identify ways to develop the 21st century skills	2.45	3.28	-.83	-.89	-.772	-27.65*	609	.000
Discuss various strategies on how to apply the 21st century skills to improve teaching and learning	2.43	3.20	-.78	-.89	-.662	-13.31*	609	.000
Session 1-K to 12 Special Topics	2.48	3.31	-.83	-.88	-.78	-31.19*	608	.000
Describe the distribution of active volcanoes, earthquake epicenters, and major mountain belts	2.41	3.26	-.85	-.91	-.792	-28.93*	609	.000
Describe the different types of plate boundaries	2.25	3.27	-1.02	-1.08	-.955	-31.88*	609	.000
Explain the different processes that occur along plate boundaries	2.22	3.21	-.99	-1.05	-.934	-33.85*	609	.000
Describe the internal structure of Earth	2.47	3.26	-.79	-.86	-.731	-25.08*	609	.000
Describe the possible causes of plate movement	2.35	3.25	-.90	-.97	-.841	-28.50*	609	.000
Describe the possible causes of plate movement	2.35	3.25	-.90	-.97	-.841	-28.50*	609	.000
Enumerate the lines of evidence that support the plate movement	2.20	3.16	-97	-1.03	-.909	-32.01*	609	.000
Session 2-Earth and Space	2.32	3.24	-.92	-.97	-.87	-34.67*	609	.000

Competencies	Mean (Pretest)	Mean (Post test)	Mean Difference	95% Confidence Interval Of the Difference		*t*	df	Sig.
				Lower	Upper			
Explain the operation of a simple electric motor and generator	2.60	3.22	-.61	-.67	-.555	-20.61*	609	.000
Compare the relative wavelengths of different forms of electromagnetic radiation	2.65	3.30	-.65	-.71	-.588	-21.49*	609	.000
Explain uses of the different forms of EM radiation	2.56	3.25	-.69	-.75	-.634	-23.07*	609	.000
Create models on how materials react to EM radiation other than light	2.33	3.11	.78	-.84	-.724	-27.16*	609	.000
Explain the effects of EM radiation to living things	2.61	3.22	-62	-.68	-.554	-19.96*	609	.000
Predict the qualitative characteristics of images formed by plane and curved mirrors and lenses	2.66	3.24	-.58	-.64	-.517	-18.88*	609	.000
Apply ray diagramming techniques in describing the characteristics and positions of images formed by lenses	2.59	3.20	-.61	-.67	-.553	-20.37*	609	.000
Identify ways in which the properties of mirrors and lenses determine their use in optical instruments	2.49	3.21	-.72	-.78	-.655	-22.47*	609	.000
Session 3-Force, Motion and Energy	2.56	3.22	-.65	-.70	-.61	-28.30*	609	.000

Competencies	Mean (Pretest)	Mean (Post test)	Mean Difference	95% Confidence Interval Of the Difference		*t*	df	Sig.
				Lower	Upper			
Explain how protein is made using information from DNA	2.17	3.17	-1.00	-1.06	-.940	-32.13*	609	.000
Explain how fossil records, comparative anatomy and genetic information provide evidence for evolution	2.17	3.10	-.93	-.99	-.873	-30.82*	609	.000
Explain the occurrence of evolution	2.28	3.13	-.86	-.92	-.793	-26.78*	609	.000
Explain how species diversity increases the probability of adaptation and survival of organisms in changing environment	2.29	3.19	-.89	-.96	-.828	-27.64*	609	.000
Session 4-Living Things and their Environment	2.24	3.17	-.92	-.98	-.87	-33.07*	609	.000
Investigate the relationship between volume and temperature at constant pressure of a gas	2.55	3.41	-.85	-.92	-.788	-25.83*	609	.000
Explain the relationship between the volume and temperature at constant pressure of a gas using the Kinetic Molecular Theory	2.44	3.29	-.85	-.92	-.790	-26.16*	609	.000
Recognize the major categories of biomolecules such as carbohydrates and proteins	2.18	3.17	-.99	-1.05	-.927	-32.34*	609	.000

Competencies	Mean (Pretest)	Mean (Post test)	Mean Difference	95% Confidence Interval Of the Difference		*t*	df	Sig.
				Lower	Upper			
Session 5-Matter	2.37	3.29	-.92	-.98	-.87	-32.76*	609	.000

*p <.05

Readiness of Science Teachers to Implement the Grade 10 of the K to 12 Curriculum

Table 5 indicates the readiness of teachers in terms of understanding the K to 12 curriculum: knowledge and skills in applying the new learning, designing instruction, assessing students using the learning standards, and the confidence to implement Grade 10 Science. The statements showed that Science teachers after undergoing the training are now ready (M ranges from 3.32 – 3.43) to implement the Grade 10 of the K to 12 Basic Education Curriculum. The training had possibly made a significant impact on the teachers' professional development in terms of knowledge and skills. Perhaps, it enabled them to perceive that they can now face the challenge of teaching the subject, and achieve the preferred outcomes of instruction.

Table 5
Readiness of Science Teachers to Implement the Grade 10 of the K to 12 Curriculum

	SD	Mean	Description
I have a clear grasp of the K to 12 curriculum	.58	3.41	Ready
I have the knowledge and skills to apply the new learning	.59	3.43	Ready
I have adequate knowledge and skills in designing instruction	.57	3.32	Ready
I have gained adequate knowledge and skills to assess students using the learning standards	.59	3.41	Ready
I have the confidence to implement the Grade 10 Basic Education Curriculum	.60	3.40	Ready
End Total	.52	3.39	Ready

Note: 3.51 – 4.00 Very *Ready*, 2.51 – 3.50 *Ready,* 1.51 – 2.50 *Moderately Ready,* 1.00 – 1.50 *Not Ready*

Teachers' Significant Learning from the Program that would be useful in Teaching Grade 10 Science

Figure 1 presents the general impression from the teacher-respondents which were immediately obtained after the training.

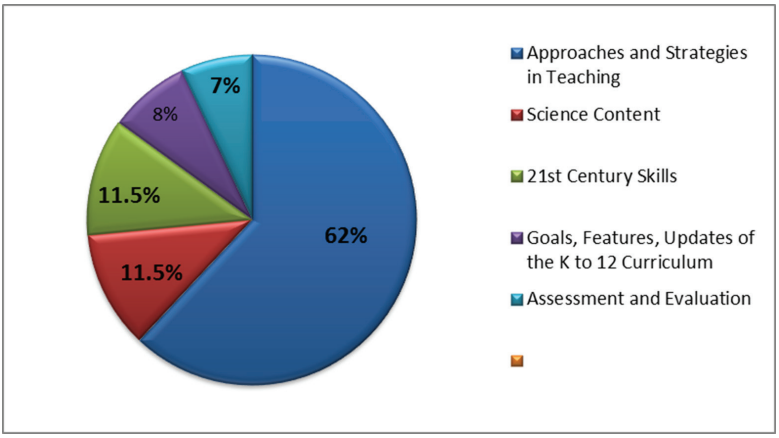

Figure1. Most Significant Learning of Teachers from the Training

Teachers admitted that they have substantial learning from the training. Topping the list are the various approaches and strategies in teaching (62%) Grade 10 Science which covers the learning competencies in Force, Motion and Energy (Physics), Earth and Space (Earth Science), Living Things and their Environment (Biology) and Matter (Chemistry). This is supported by their readiness (M ranges from 3.32 – 3.43) in teaching the subject. This result is not far from the results of the research conducted by Arellano and Jusayan (2015) on the competencies and readiness of Science Teachers.

Among the strategies, contextualization and localization/ indigenization gained much attention followed by differentiated instruction. Perhaps teachers this time teachers are more appreciative on the use of localized materials and the importance of considering the uniqueness of their students in teaching Science. One participant teacher said,

> *We don't need high tech equipment in our process of teaching and effecting learning to our students. What we need is to use the available materials in our locality for student's better understanding of our lesson.*

Another added,

> *I learned how localization and contextualization must be integrated in the class, it would be of help to let the students understand the lesson at their own level of understanding." One teacher also mentioned, "I have learned that differentiated instruction must be observed for the student with multiple intelligences which can now be observed inside our classroom.*

These are clear manifestations that teachers are now very sensitive to the needs of the learners.

Science content and 21st Century skills were also learned significantly (both at 11.5%). It is a known that if teachers have learned the content and the mastery of the skills needed in teaching Grade 10 Science, the selection of the suitable strategy for a particular concept will be easier for them. As teachers advance through their learning experiences in teaching the K to 12 Curriculum in Science at a higher level, the more competence they gained. This can probably increase their efficacy and self-confidence in teaching. This outcome confirms too the results of the study of Arellano and Jusayan (2012).

The other perceived important learning was on the Goals, Features and Updates K to 12 Curriculum (8%). Perhaps the training made the teachers acknowledge more the importance of this new curriculum considering that the country had just responded to the demands of time; that it's the educational system will be comparable with other countries when as far as the number of years prior the tertiary level is concerned. Assessment and Evaluation comes next (7%). Assessment is an essential component of a teaching and a critical step in the learning process because it helps students learn. Moreover, it determines whether or not the objectives of the day's lesson have been met (http://study.com/academy/lesson/the-importance-of-assessment-in-education.html. Retrieved 11/17/17). This feasibly have a great impact on teachers; hence, they considered this as valuable fact gained from the training. As participants said,

> *I learned that assessment is very important. Another added that, Assessment is a tool so that I can closely track my learners' performance.*

One participant concluded that,

K to 12 BEC updates through DepEd Order No. 8 helped me to implement the new way of assessing and recording students' outcomes.

Challenges Grade 10 teachers expect when they implement the Grade 10 Science of the K-12 Basic Education Curriculum

Teachers were also open when asked about the possible challenges they anticipate to encounter when implementing Grade 10 Science. The results are reflected in Figure 2.

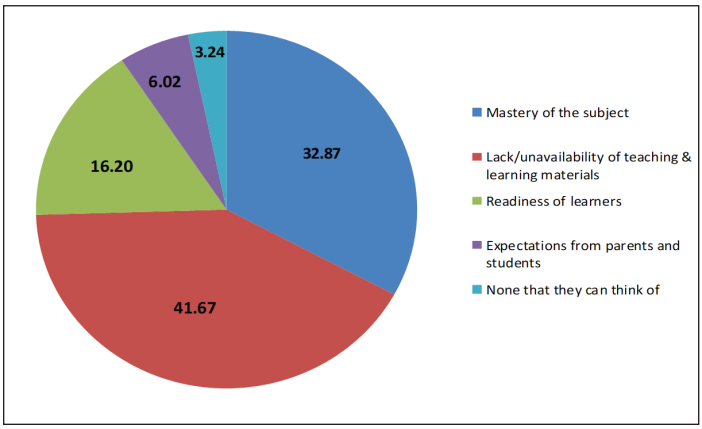

Figure 2. Teachers' Expected Challenges in Implementing Grade 9 Science

Most of teachers are challenged and apprehensive to teach the subject. Their anxiousness to teach is rooted on their lack of mastery of the subject (41.67%), considering that most of them are graduates of specialized courses. Though they also perceived that they have learned something and have been reviewed on some difficult contents from the four learning areas of Science namely: Earth and Space; Matter; Living Things and their Environment; and Force, Motion and Energy, this attempt to mastery seems to be lacking to make them comfortable teaching the subject. As teachers pointed out,

Topics in Grade 10 Science are complex ones compared to the lower level.
New curriculum means another adjustment and I'm inexperience to teach other learning areas in the subject.
This is a great challenge especially when I teach the area which is not the field of my specialization.

Another expected challenge is the lack or unavailability of teaching and learning materials (32.87%). As experiences, if ever there are, these are not enough for the students. Teachers pointed out that,

> *There are not enough materials and equipment in our school in the conduct of experiments and activities contained in LM (Learning Materials).*

> *As experienced, I'm spending my own money for the materials to be able to teach.*

And to this concern, she is again concerned that the same scenario will happen. For some, they are worried that the allotted time is not enough to teach the learning competencies considering that there are many topics to be covered.

The third expected challenge is the readiness (16.20%) of Grade 10 learners. Teachers are worried about how their students will respond to the new lessons. They know that they will have another adjustment to be made. Several teachers mentioned that,

> *I will have again another set of students, another adjustment. Thus, more work to innovate and create activities suited to the learner's skills especially that students' attitude varies in this digital generation.*

> *For heterogeneous class the approaches/strategies may interest to some students but not to others. In our part we must think of some effective strategies where slow learners can also learn.*

> *I might encounter learners which are resistant to change especially in the implementation of this K to 12 Curriculum, 21st century skills and contextualization and localization. This is another burden.*

Another anticipated trial is the big expectations from parents and students (6.02%). Teachers are worried about this since they were able to undergo the training, learners as well as their parents are looking forward for the full implementation of what they have gained from it. Teachers are afraid that their coping mechanism might be affected. On the positive side, it is refreshing to note that there were some who perceived that there is none (3.24%) to be worried of. They see the different challenges as opportunities to broaden their field of expertise in teaching Science. Several teacher said,

So far, so good. Keep up the Good work!

I am expecting a lot of experience and challenges along the way because of this change but I'm positive about K to 12.

Conclusions and Recommendations

Grade 10 Science teachers before the training perceived themselves to have average competencies both in Force, Motion and Energy and in the Overall Content of the Program focusing on the K to 12 Program Updates, Challenges to the K to 12 Program, Insights on Ways to Advocate the K to 12 Program, and Key features of Grade 10 Science. This seems to suggest that teachers have satisfactory knowledge as far as competencies at these two areas concerned. However, they still need to practice the competencies to be able to achieve mastery in teaching the subject with ease and efficacy. Conversely they have low competencies in K to 12 Special Topics which includes: Earth and Space, Living Things and their Environment, and in Matter. This may suggest that they seem to be inadequate in teaching the subject areas mentioned due to the insufficient understanding they have on the topics to be covered. After the training however, this perception was also elevated to the average with a slight increase in the mean scores in each area. It appears that teachers profess to have adequate set of capabilities gained from the training. Nevertheless, they still need to apply knowledge and skills when they teach in actual classroom situations.

The significant difference in the competencies between the pre-post Program Assessment of the teachers seems to imply that science teachers believe that training have contributed to their inherent competencies to implement Grade 10 science. This suggests that teachers have learned the necessary concepts, skills, and attitudes as embodied in the competencies in the course of the training. It can be deduced further that the K to 12 Teacher Training in Science was able to accomplish its desired objectives.

Teachers appear also to be ready to implement Grade 10 Science of the K to 12 Basic Education Curriculum. The training had possibly made a significant impact on their pedagogy and skills development. This feeling gives the idea that they can now face the challenge of teaching the subject even though they are graduates of different disciplines, more so that the course will be delivered in spiral progression.

Substantial learning was also attained from the training as admitted by the teachers. These included: (1) various approaches and strategies in teaching especially on contextualization, localization or indigenization, and differentiated instruction; (2) Science content and 21st Century skills; and (3) the Goals, Features and Updates of the K to 12 Curriculum. It could be seen that when teachers advance through more enriched learning experiences, the more competent they are. Consequently they become more efficacious.

Teachers also expect challenges when they return to their respective station to implement the new Grade 10 Science curriculum. Topping the list is their lack of mastery of the subject. This maybe beacause the group of teacher trainees is heterogeneous when it comes to their respective disciplines or courses. Perhaps they feel that they will be inefficient in teaching the subject. Another challenge is lack or unavailability of teaching and learning materials. Teachers still anticipate the perennial problem of scarcity of teaching and learning materials such as books, laboratory chemicals, and equipment. It can be assumed that the same condition happens in the next school years. The Department of Education however, sees that these will be addressed in due time. On the upside there were some who perceived that there is nothing to worry about with the implementation of Grade 10 Science. Conceivably, these are the teachers who looked at the change in their usual teaching career as a chance to experience something new and be more appreciative of every opportunity that comes in their way.

Various recommendations are suggested to help address these different teachers' concerns. If time and financial concerns permit, perhaps a follow-up intensive upgrading training both on content and pedagogy in Earth Science, Biology, Chemistry and Physics for 2 weeks be given especially intended for non-major teachers of the subjects mentioned. The supplementary knowledge and skills can help them attain mastery of science concepts at a certain level that can help them. This will not only boast teachers' morale but more importantly the feeling of helplessness can be addressed among them.

Aside from having a walk-through of the topics as usually practiced during training, teachers could also be given time to do lesson exemplars collaboratively. They can use inquiry-based learning, contextualization, improvisation, and other strategies when applicable. This will help develop their creativity and may answer the usual problem on materials deficiency when doing laboratory activities. It is a known fact that learning is more

meaningful when students are actually doing or simulating to know science concepts and principles. It should be noted however, that assessment should be a valuable component of their prepared lesson exemplars.

It is also suggested that the Department of Education may include as part of their agenda to monitor and evaluate the different trainings, implemented focusing on the K to 12 Science Curriculum. This can assess whether the objectives of the program were really attained. Perhaps, moves can be made to resolve problems encountered along the way.

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