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Development and Evaluation of Modules for Senior High School Physics Teachers

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ABSTRACT

This is a developmental research study with the purpose to design, develop and evaluate instructional modules for Senior High School Physics teachers. ADDIE Model was used as the developmental design. This study included 34 Senior High School physics teachers from the 20 schools (DepEd Public Schools, Private Schools, Colleges and Universities and State Colleges and Universities) in the City and Province of Iloilo. A duly validate and reliability tested researcher-made questionnaire was utilized to gather data needed for the study. Assessments on the levels of readiness revealed that Senior High School physics teachers have a low level of readiness in Electricity and Magnetism, and Modern Physics. Findings also revealed that Senior High School physics teachers have a low extent of coverage of the learning competencies in Physics as required by the Department of Education. Results also showed that the Senior High School physics teachers were mostly master's degree graduates of other fields not of physics program, teaching physics for less than 5 years, and have not any Physics-related seminars. The modules were found to be excellent by both the Experts and Physics teachers in terms of the objectives, content, format and language, presentation, and usefulness. They showed high potential in terms of its usage and effective instructional materials in improving the quality of instruction and in improving students' performances in Physics.

Keywords: instructional modules, developmental design, modern physics

INTRODUCTION

Background of the Study

The sudden implementation of the K-12 curriculum teachers have experienced lack of support from the government especially in providing teaching materials needed for the Senior High School physics curriculum. Moreover, the sudden implementation has also forced some school's administrators to hire new graduates and teachers who were not graduates of physics programs, but of other fields such as Engineering, Chemistry, Biology and General Science to teach physics.

Physics teachers who are underqualified, cannot be expected to perform satisfactorily. As observed, the lack of understanding and knowledge on the concepts and principles in physics are believed to hinder physics teachers from discussing the topic. Teachers who do not understand the subject themselves cannot possibly develop deep conceptual understanding of physical principles in their students. Hence, they only teach the topics which they feel they are knowledgeable and prepared to teach. According to Sulaiman, et al., (2017), teachers who are not ready to perform their duties and yet teaching will result in students' lack of enthusiasm.

Teaching physics in senior high school requires necessary learning and teaching materials to make the learning process easy and enduring. Teaching materials are not only used to facilitate the independent learning process of the students but also to make it convenient for teacher to convey a message to students in an accurate, proper, clear and understandable manner; in making abstract knowledge concrete and in enabling students to comprehend complex ideas through simplification (Saglam, 2011). Moreover, the use of appropriate teaching materials, compliance of teaching requirements and teaching experiences of physics teachers can develop students' interest to learn physics and to feel that physics is not boring.

The development of instructional materials in the form of modules is one of the important educational innovations in instructional design. It is believed that the modules can be excellent supplementary materials not only for the students but also for the teachers in enhancing their competencies. Furthermore, these instructional materials can be of great help for effective instructions in order to enhance the quality of learning both for the students and teachers. These teaching materials can be a source of information to validate ideas that can be used to discuss and explain the correct concepts and principles of physics.

Objectives of the Study

The main purpose of this research study was to assess the content knowledge of teachers in physics and to design, develop and evaluate instructional modules for Senior High School physics teachers.

Theoretical Framework

The present study adopted the instructional design theory which according to Smith (1998) is the study on how to design the best instruction in order for learning to take place. The ADDIE model was used in the preparation of the module. This is a well-known model commonly used for creating instructional materials. This acronym stands for five stages of the material development; A for Analyze, D for Design, D for Develop, I for Implement, and E for Evaluate (Kurt, 2017).

Guided by this model, the researcher developed a module to minimize, if not eliminate, the difficulties of teachers particularly in teaching physics for Senior High School.

Fig. 1 shows the ADDIE Model used in this study.

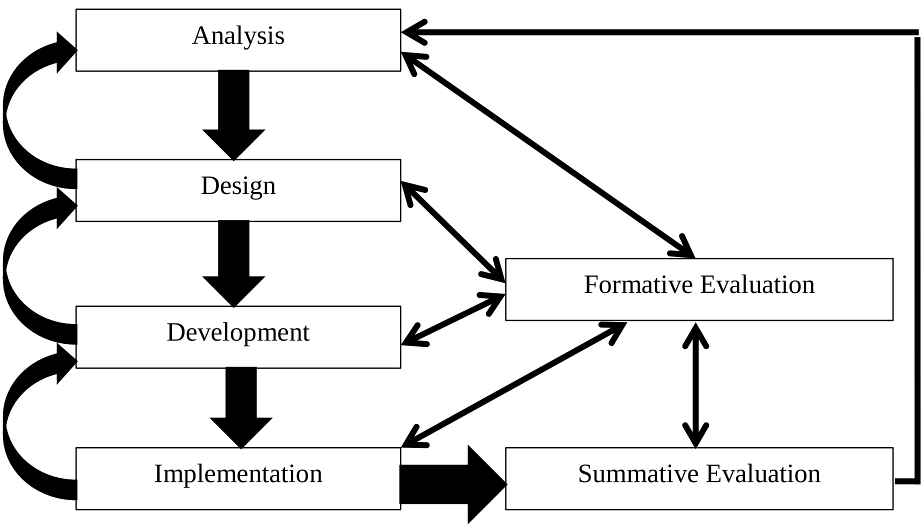

Figure 1. The ADDIE Model

Scope and Limitation of the Study

This study focuses on the design, development and evaluation of instructional modules for Senior High School physics teachers. As surveyed, there were 47 schools with 66 physics teachers in the City and Province of Iloilo which includes DepEd Public Schools, Private Schools and Colleges, and State Colleges and Universities offering Senior High School STEM Program. Of the 47 schools, only 20 (42.55%) schools agreed to participate with 34 out of 66 (51.5%) qualified physics teachers willingly participating in the survey in the City and Province of Iloilo.

ADDIE model was used in designing and developing a module in physics for Senior High School teachers believing that the outcome can be a help for the teachers to cover all the learning competencies required by the Department of Education.

A researcher-made questionnaire was utilized in collecting all data needed for the assessment phase. The questionnaire made by the researcher was duly validated by a jury of validators and which also underwent reliability testing using the Kuder–Richardson Formula 20. The collected data from the questionnaires were analyzed as bases to design, develop and evaluate instructional modules for Senior High School physics teachers.

METHODOLOGY

This study was conducted in two stages: First, the assessment survey, and second, the preparation of the module using the ADDIE model.

The present study utilized the development research approach to establish an empirical basis for the creation of instructional products, which are self-instructional modules.

The Assessment Survey

The assessment considered the teachers' highest educational attainment, number of years teaching physics, number of physics-related seminars attended, number of hours physics-related seminars attended, and teaching methods/approaches as indicators of preparedness and readiness.

The survey involved identification of the study area and target population, determination of the study sample, the preparation of data gathering instruments, data gathering and data analysis.

Preparation of Module using ADDIE Model

The preparation of the module for the Senior High School physics teachers in teaching physics included the (a) analysis phase, (b) designing phase, (c) developing phase, (d) implementation phase, and (e) evaluation phase.

DATA ANALYSIS AND INTERPRETATION

Readiness of Physics Teachers in Terms of their Professional Competencies

Educational Attainment

The figures reveal that of the 34 senior high school physics teachers involved in the study, the majority (58.8%) were graduates of degrees in other fields and 41.2% were graduates of physics programs. Of those with physics background, seven (20.6%) had a Bachelor's degree major in Physics, and the same number had a master's degree in Physics (20.6%).

Number of Physics-related Seminars Attended

In terms of the number of physics-related subjects they had attended, less than half (47.1%) opted not to respond to the inquiry and were classified as not having attended. Of the 52.9% who claimed attendance, 11.8% had attended only one physics-related seminar (20.6%) and the same number of respondents had attended two (20.6%) and 3 or more physics-related seminars (20.6%), respectively.

Number of Years' Experience in Teaching Physics

The table also shows that 50% of the respondents have been teaching Physics for 5 years or less, 7 or 20.6% of physics teachers had been teaching physics for 6 – 10 years while 29.4% have been teaching physics for more than 10 years.

Table 1
Professional Competencies of Respondents in terms of Highest Educational Attainment, Number Physics-Related Seminars attended, and Number of Years' Experience in Teaching Physics.

Professional Competencies	N	%
Highest Educational Attainment		
Bachelor's Degree (Major in Physics)	7	20.6
Bachelor's Degree (Other Fields)	8	23.5
Master's Degree Graduate (Major in Physics)	7	20.6
Master's Degree Graduate (Other Fields)	10	29.4
Doctoral Degree	2	5.9
Total	**34**	**100.0**
Number of Physics-Related Seminars Attended		
Never Attended	16	47.1
1	4	11.8
2	7	20.6
3 or More	7	20.6
Total	**34**	**100.0**
Number of Years Teaching Physics		
5 Years or Less	17	50.0
6 - 10 Years	7	20.6
11 – 15 Years	4	11.8
16 Years or More	6	17.6
Total	**34**	**100.0**

Professional Readiness of the Respondents

Table 2 shows the distribution of respondents by level of professional readiness based on the three categories. The figures show that 58.8% of physics teachers were moderately ready to teach physics, 29.4% were not ready while only 11.8% were very ready to teach the subject. The findings indicate that most of the teachers included in the study still need to continue pursuing educational advancement in the area of physics, by either attending seminars, or upgrading their professional qualification and gaining more experience in teaching physics.

Table 2
Level of Readiness of Respondents in terms of their Professional Competencies.

Level of Readiness	N	%
Not Ready (0 - 3)	10	29.4
Moderately Ready (4 – 7)	20	58.8
Very Ready (8 – 10)	4	11.8
Total	**34**	**100.0**

Readiness of Respondents in terms of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics

To determine the content knowledge of respondents, the researcher tested how much the teachers knew about physics, particularly Electricity and Magnetism, Optics and Modern Physics. A 45-item questionnaire composed of 15 items about Electricity and Magnetism, 15 items about Optics, and 15 items about Modern Physics. The test items were based on the learning competencies required by the Department of Education. The questionnaire was submitted for validation by three experts with Master degree and Doctoral degree with specialization in physics and who have been teaching physics for more than 15 years.

Electricity and Magnetism

The figures in Table 3 show that 12 out of the 15 questions for Electricity and Magnetism was answered correctly by the respondents. The top 4 items were answered correctly by more than 80% while the 3 lowest items were questions where more than 50% of the respondents failed to answer correctly.

The top 3 items which were answered correctly by the respondents requires only simple understanding about the concept and simple application using the principles of Electricity and Magnetism. On the other hand, the 3 lowest items where more than 50% of respondents failed to answer correctly require a deeper understanding of the concept and principle of electromagnetism and its application using the derived formulas. Most students or teachers may be confused about the effect of heat on the property of a metal, whether its resistance to the flow of current will be hindered or enhanced. Likewise, students or teachers may find it difficult to apply the concept of electromagnetism to a problem, maybe because they were not familiar with electromagnetism. Hence, they may feel confused about what appropriate formula or formulas will be used to answer the required values.

Table 3
Distribution of Respondents in terms of their Content Knowledge in Electricity and Magnetism.

Electricity and Magnetism	Correct	
	f	%
Questions		
1. The passage of charge of 1 Coulomb through a section of the conductor per second.	33	97.1
2. An electric heater draws a current of 20 A when connected to a 120-V power source. Its resistance is…	32	94.1
3. In drawing magnetic field lines, the stronger the field…	31	91.2
4. A quantity which is numerically equal to the resistance offered by a conductor of unit length and unit cross section to the passage of a current with the current flowing in a direction perpendicular to the cross section.	30	88.2
5. A force which a test charge experiences when placed in an electric field.	26	76.5
6. The equivalent resistance of a 10 Ω resistor and a 30 Ω resistor connected in parallel is…	23	67.6
7. An electrode where the conventional current leaves.	22	64.7
8. A +30 μC charge is attracted to a -90 μC charge with a force of 1.8 N. How far apart are the charges?	21	61.8
9. It is a solenoid which is bent to form a ring.	20	58.8
10. Two identical resistors in parallel have an equivalent resistance of 2 Ω. If the resistors were in series, their equivalent resistance would be…	20	58.8
11. A 200-m length of copper wire has a resistance of 2Ω ($\rho = 1.72 \times 10^{-8}$). Its cross sectional area is…	18	52.9
12. All magnetic fields originate from…	17	50.0
13. A flat circular coil of 50 turns has a radius of 3 cm. What is the magnetic induction at the center if a current of 5 A is passed through it ($k = 12.5664 \times 10^{-7}$)?	10	29.4
14. The property of ferromagnetic materials to acquire magnetic properties when under the influence of a magnet.	4	11.8
15. If the temperature of a copper wire is raised, its resistance…	2	5.9

Optics

The data show that 13 out of 14 items in Optics were answered correctly by more than 50% of the respondents. This shows that more than 50% of respondents find it easy to understand and analyze concepts and principles of Optics. Due to the nature or characteristics of light, respondents are able to connect the principles of Optics to their daily activities that require its application. The top 5 items were mostly answered by more than 80% of the respondents that require only the analysis on the characteristics of light as a wave. The last 2 items however, were items that require more analysis and application of the concept of mirror images that requires diagrams to be constructed. Teachers and students may find it difficult to understand and feel hard to answer.

Table 4
Distribution of Respondents in terms of their Level of Content Knowledge in Optics.

Optics	Correct f	Correct %
Questions		
1. A pencil is placed in a glass of water. The pencil appears to be bent. This is an example of …	32	94.1
2. The bending of light when it passes through two media of different densities…	30	88.2
3. These are lights that vibrate in one direction…	30	88.2
4. In a vacuum, the speed of an electromagnetic wave…	29	85.3
5. The ratio which compares the size of the image with the size of the object…	29	85.3
6. When white light disperses, which of the following colors has the shortest wavelength?	27	79.4
7. If image distance is negative, the image is…	26	76.5
8. The lens of the eye forms an image on the retina that is…	25	73.5
9. A concave mirror produces an erect image when the object distance is…	23	67.6
10. The point where parallel rays converge after reflection from a concave mirror, or the point from which they appear to diverge after reflection from a convex mirror…	23	67.6
11. The difference in the light emitted from a candle, an incandescent lightbulb, and the sun is basically from the difference in…	21	61.8
12. An object placed before a converging lens at a point which is less than the focal length produces an image which is always…	20	58.8
13. An object is 7.62 cm tall and is 50.8 cm from the double convex lens. A real image is formed 25.4 cm from the lens. What is the focal length of the lens?	17	50.0
14. An image formed which the outgoing rays really do pass through the image point…	16	47.1
15. How many hours are required before a radio signal from a space probe near the planet Pluto reaches Earth, 6.00 x 10^9 km away…	10	29.4

Modern Physics

Table 5 presents findings that 12 out 15 items about Modern Physics were correctly answered by 50% of the respondents. The top 3 items were being answered correctly by more than 80% of the response considering that these are simple concepts about an atom and its characteristics. These questions can be easily understood by applying the common idea about an atom and the characteristics of its sub-atomic particles. On the other hand, the lowest 3 items included in the questionnaire require inquiries where more than 50% of the respondents failed to answer. These questions require thorough analysis and deeper understanding about the concept and behavior of particles. Teachers and students may find it difficult to deal with this topic and mostly fail to give the correct answer.

Table 5
Distribution of Respondents in terms of their Content Knowledge in Modern Physics.

Modern Physics	Correct	
	f	%
Questions		
1. The nuclear reaction that takes place when a nucleus split into more stable and less massive nuclei following the release of energy is called nuclear..	31	91.2
2. The separation of white light into its components when it passes through the prism.	31	91.2
3. It refers to the sum of the number of protons and number of neutrons in the nucleus of an atom.	28	82.4
4. Which of the following is an electron emitted by a nucleus as it undergoes radioactive decay?	25	73.5
5. Electromagnetic photons which are identical in nature and properties as x-ray photons of the same energy but are emitted by a radioactive nucleus.	24	70.6
6. The ejection of beta particles from the nucleus results in…	23	67.6
7. Isotope A has a half-life of seconds, and isotope B has a half-life of millions of years. Which isotope is more radioactive?	21	61.8
8. The radiation which is emitted by radioactive elements and is identical to cathode rays.	21	61.8
9. An isotope of an atom with atomic number greater than 83 will probably emit…	19	55.9
10. Which of the following types of radiation will not penetrate clothing?	18	52.9
11. Large nuclei with an atomic number greater than 83 decay by…	18	52.9
12. When alpha particles strike screens of fluorescent materials they produce flashes of light called…	17	50.0
13. A spaceship flies past earth at a speed of .990*c*. A crew member on board the spaceship measures its length, obtaining the value 400m. What length do observers measure on earth?	12	35.3
14. Which of the following will most likely happen to an alpha particle after it is emitted?	8	23.5
15. Find the rest energy of an electron ($m = 9.109 \times 10^{-31}$ kg) in (a) joules and in (b) electron volts ($q = -e = -1.602 \times 10^{-19}$C).	8	23.5

Based on the result of the test to determine the content knowledge of respondents for the areas of Electricity of Electricity and Magnetism, Optics and Modern Physics, more than 50% of the respondents mostly answered the items correctly. The data show that more items in Optics were being answered correctly by more than 80% of the respondents than in Electricity and Magnetism and Modern Physics. This shows that more of the respondents find it easy to analyze and understand concepts and principles about Optics than in Electricity and Magnetism and Optics.

Level of Content Knowledge in Physics

As mentioned previously, correct answers of the test questions were checked and the total score for each area and the combined total were used to determine the level of knowledge of teachers using the following categories: Below 10 (Low level of knowledge), 10 – 12 (Average level of knowledge) and 13 – 15 (High level of knowledge). Moreover, the items which were not correctly answered by most of the respondents were identified and used to determine what topics in the physics teachers need improvement. The data were also used to determine the teachers' readiness to teach the subject.

As discussed earlier, more than 50% of the respondents answered correctly the test items to determine their content knowledge about Electricity and Magnetism, Optics and Modern Physics. Also in the discussion, more items in Optics were answered correctly by more than 80% of the respondents compared to the items included for Electricity and Magnetism and Modern Physics. This shows that most of the respondents find easy to understand the questions for Optics and can make simple analysis to get the correct answer.

The figures reveal that 52.9% of the respondents have a low level of knowledge, 38.2% have an average level of knowledge and 8.8% have a high level of knowledge in Electricity and Magnetism. Likewise in the area of Optics, results show that 50% of the respondents have average level of knowledge, 26.5% have low level of knowledge and 23.5% have high level of knowledge about the topic. Also, the figures show that for the area of Modern Physics, 55.0% of the respondents have average level of knowledge, 35.3% have low level of knowledge, and 8.8% have high level of knowledge.

The findings show that based on the respondents' scores in physics, the majority of the respondents performed better in Optics (50.0%) and Modern Physics (55.0%) but low in Electricity and Magnetism (52.9%). The higher proportion of respondents with low level of knowledge in Electricity and Magnetism can be attributed to the lack of background information about the subject which they find difficult to understand the concept and principle about the topic. Hence, they failed to answer the questions correctly.

Table 6
Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics.

Level of Knowledge	Electricity and Magnetism		Optics		Modern Physics	
	f	**%**	**f**	**%**	**f**	**%**
Low (below 10)	18	52.9	9	26.5	12	35.3
Average (10 – 12)	13	38.2	17	50.0	19	55.0
High (13 – 15)	3	8.8	8	23.5	3	8.8
Total	**34**	**100.0**	**34**	**100.0**	**34**	**100.0**

Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Highest Educational Attainment

Electricity and Magnetism

The findings reveal that teachers who were graduates of physics programs had higher levels of knowledge in Electricity and Magnetism than teachers who were graduates of other fields. This confirms that as a whole, teachers with physics backgrounds were more knowledgeable in Electricity and Magnetism than graduates of other fields as shown by the mean score of 10. 86 compared to 9.50 and 9.10, respectively.

The high level of knowledge of teachers who were graduates of physics programs may be attributed to their learning acquired during their studies. In contrast, teachers who were graduates of other programs have a low level of knowledge in Electricity and Magnetism and thus were not ready to teach the subject.

The findings of this study support the idea that "the lack of understanding and knowledge on the concepts and principles in Physics are believed to be some factors that also hinder Physics teachers not to discuss the topic." According to Chung, et.al. (2002), teachers who are not professionally aligned felt that they are inadequately prepared to deal with the daily teaching tasks like planning instruction, teaching subject matter, using instructional strategies and differentiating instruction. Hence, they only teach the topic which they feel they are knowledgeable and prepared for.

Optics

The findings also show that a higher proportion of teachers who were graduates of physics programs have an average level of knowledge in Optics than teachers who were graduates of other fields. This also conforms to the result that teachers with physics backgrounds were more knowledgeable in Optics than those of other fields.

Modern Physics

The figures in Table 7 show that teachers who were graduates of physics programs had a higher level of knowledge in Modern Physics than teachers who were graduates of other fields. The mean score of 10.00 and 10.86 compared to 8.63 and 9.0, respectively indicate that teachers who have physics background are more knowledgeable about Modern Physics than graduates of other fields.

The results of the study support to the findings of Boyd, Grossman, Lankford, Loeb & Wyckoff (2005) that student achievement is most enhanced when teachers are fully certified, and have completed a teacher education program while Harris & Sass (2006) found out that teacher qualifications and in-service training affected student achievement in Florida. The findings of Ingersoll (1999) also showed that secondary school science teachers teaching the subject without full certification caused significant concern about the science children may or may not be receiving.

Table 7

Distribution of Respondents in terms of their Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Highest Educational Attainment.

Level of Content Knowledge	Highest Educational Attainment									
	Bachelor's degree (Other Fields)		Master's and Doctoral degrees (Other Fields)		Bachelor's degree Major in Physics)		Master's degree (Major in Physics)		Total	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Electricity and Magnetism										
Low (Below 10)	5	62.5	8	66.7	3	42.9	2	28.6	18	52.9
Average (10 – 12)	3	37.5	3	25.0	4	57.1	3	42.9	13	38.2
High (13 – 15)	0	0	1	8.3	0	0	2	28.6	3	8.8
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**
Mean		**9.50**		**9.10**		**9.23**		**10.86**		
Optics										
Low (Below 10)	4	50.0	3	25.0	1	14.3	1	14.3	9	26.5
Average (10 – 12)	4	50.0	5	41.7	4	57.1	4	57.1	17	50.0
High (13 – 15)	0	0	4	33.3	2	28.6	2	28.6	8	23.5
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**
Mean		**9.25**		**11.2**		**11.86**		**11.86**		
Modern Physics										
Low (Below 10)	4	50.0	5	41.7	2	28.6	1	14.3	12	35.3
Average (10 – 12)	4	50.0	7	58.3	3	42.9	5	71.4	19	55.9
High (13 – 15)	0	0	0	0	2	28.6	1	14.3	3	8.8
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**
Mean		**8.63**		**9.00**		**10.00**		**10.86**		

Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Number of Physics-Related Seminars Attended.

Electricity and Magnetism

Findings reveal, that teachers who attended 2 or more physics-related seminars had higher levels of knowledge in Electricity and Magnetism than teachers who had one attendance or never attended any physics-related seminars. This also shows that physics teachers who had more attendance in any physics-related seminars are more knowledgeable in Electricity and Magnetism than those who had never attended.

Optics

The figures also show that teachers who had more attendance in any physics-related seminars are more knowledgeable about Optics than teachers who had less attendance in any physics seminars. Hence, these teachers are ready to teach the subject.

Modern Physics

The figures in Table 8 also show that teachers with more attendance in any physics-related seminars are more knowledgeable and have better understanding about the concept of Modern Physics than the teachers who had attended less than 3 or never attended any physics-related seminars. This was indicated by the mean score of 10.86 compared to 9, 50, 9, 25, and 8.57, respectively. The results also show that teachers who had attended 3 or more physics-related seminars are ready to teach Modern Physics.

Table 8
Distribution of Respondents in terms of Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Number of Physics-Related Seminars Attended.

Level of Content Knowledge	Number of Physics-Related Seminars Attended									
	None		1 Seminar		2 Seminars		3 or More Seminars		Total	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Electricity and Magnetism										
Low (Below 10)	9	56.3	5	45.5	2	66.7	2	50.0	18	52.9
Average (10 – 12)	6	37.5	5	45.5	0	0	2	50.0	13	38.2
High (13 – 15)	1	6.3	1	9.1	1	33.3	0	0	3	8.8
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**
Mean		**9.19**		**9.58**		**9.57**		**9.71**		
Optics										
Low (Below 10)	4	25.0	5	45.5	0	0	0	0	9	26.5
Average (10 – 12)	10	62.5	4	36.4	1	33.3	2	50.0	17	50.0
High (13 – 15)	2	12.5	2	18.2	2	66.7	2	50.0	8	23.5
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**
Mean		**10.44**		**11.00**		**9.71**		**13.14**		
Modern Physics										
Low (Below 10)	5	31.3	6	54.5	1	33.3	0	0	12	35.3
Average (10 – 12)	9	56.3	5	45.5	2	66.7	3	75.0	19	55.9
High (13 – 15)	2	12.5	0	0	0	0	1	25.0	3	8.8
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**
Mean		**9.25**		**9.50**		**8.57**		**10.86**		

Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Number of Years' Experience in Teaching Physics

Electricity and Magnetism

The findings show that teachers who had been teaching physics for 16 years or more are more knowledgeable and have better understanding and analysis about the concepts, principles and laws of Electricity and Magnetism than teachers who had lesser experience in teaching physics. Teachers who are knowledgeable about the topic are ready to teach the subject.

The findings of this study conform to the findings of Bonney, et.al. (2015) proving that pupils perform better when they are taught by well experienced teachers, teachers with long teaching experience teach better than teachers with little or no experience, teachers' teaching experience is very vital in promoting higher academic performance. Owolabi (2007), Abraham and Morrison (2006) and Darling Hammond (2000) also agree that teachers' years of experience as a measure of quality is important in the achievement of students' academic performance.

Optics

The figures reveal that teachers who have been teaching physics for more than 5 years are more knowledgeable in Optics than teachers who taught physics for 5 years or less. This implies that teachers who had longer teaching experience in physics are ready to teach the subject.

Modern Physics

The findings show that teachers who had been teaching physics for more than 10 years are more knowledgeable in Modern Physics than teachers who had been teaching physics for less than 10 years. This also proves that teachers who had longer experience in teaching physics are more exposed with the concept and principles of Modern Physics and acquired more knowledge about the subject. Hence they are prepared and ready to teach the subject.

The findings of this study also proved the claims of Rosenholtz (1986) that inexperienced teachers (those with less than 3 years of experience) are not more effective than more senior teachers. The study of Bonney, et.al. (2015) also proved that teachers with long teaching experience teach better than teachers with little or no experience and Diamante (1997) also found out that teachers with longer experience exhibit significantly better performance than those with shorter experience.

Table 9

Distribution of Respondents in terms of Level of Content Knowledge in Electricity and Magnetism, Optics and Modern Physics according to Number of Years' Experience in Years in Teaching Physics.

Level of Content Knowledge	Number of Years' Experience in Teaching Physics									
	5 Years and Below		6 – 10 Years		11 – 15 Years		16 Years or More		Total	
	f	%	f	%	f	%	f	%	f	%
Electricity and Magnetism										
Low (Below 10)	8	47.1	4	57.1	4	100.0	2	33.3	18	52.9
Average (10 – 12)	7	41.2	3	42.9	0	0	3	50.0	13	38.2
High (13 – 15)	2	11.8	0	0	0	0	1	16.7	3	8.8
Total	**17**	**100.0**	**7**	**100.0**	**4**	**100.0**	**6**	**100.0**	**34**	**100.0**
Mean		**9.25**		**9.29**		**9.75**		**10.67**		
Optics										
Low (Below 10)	7	41.2	0	0	0	0	2	33.3	9	26.5
Average (10 – 12)	7	41.2	4	57.1	3	75.0	3	50.0	17	50.0
High (13 – 15)	3	17.6	3	42.9	1	25.0	1	16.7	8	23.5
Total	**17**	**100.0**	**7**	**100.0**	**4**	**100.0**	**6**	**100.0**	**34**	**100.0**
Mean		**10.24**		**11.86**		**12.00**		**11.00**		
Modern Physics										
Low (Below 10)	7	41.2	2	28.6	1	25.0	2	33.3	12	35.3
Average (10 – 12)	8	47.1	5	71.4	3	75.0	3	50.0	19	55.9
High (13 – 15)	2	11.8	0	0	0	0	1	16.7	3	8.8
Total	**17**	**100.0**	**7**	**100.0**	**4**	**100.0**	**6**	**100.0**	**34**	**100.0**
Mean		**9.00**		**9.71**		**10.00**		**10.17**		

Teaching Approaches/Methods/ Strategies in Teaching Physics

Based on the results, the most common teaching strategies or methods used by teachers in teaching physics were the combination of Lecture/Discussion/ Interactive Demonstration with Interactive Instruction (Cooperative Learning, Experimentation, Problem Solving, Hands-on activity).

Table 10
Respondents' Teaching Methods or Strategies in Teaching Physics.

Teaching Approaches, Methods or Strategies in Teaching Physics	N	%
1. Lecture/Discussion/Interactive Demonstration with Interactive Instruction(Cooperative Learning, Experimentation, Problem Solving, Hands-on activity)	11	32.4
2. Lecture/Discussion/Interactive Demonstration with Problem-based and Project-based Instruction	8	23.5
3. Lecture/Discussion/ Interactive Demonstration with Indirect Instruction (Problem Solving, Inquiry, Reporting)	7	20.6
4. Lecture/Discussion/Interactive Demonstration with Interactive Instruction (Cooperative Learning, Experimentation, Problem Solving, Hands-on activity), Indirect Instruction (Problem Solving, Inquiry, Reporting), Problem-based and Project-based Instruction	5	14.7
5. Lecture/Discussion with Problem-Based Instruction	2	5.9
6. Lecture/Discussion/Interactive Demonstration with Simulation	1	2.9
Total	**34**	**100.0**

Extent of Coverage of Learning Competencies Required by the Department of Education (DepEd)

Coverage on Electricity and Magnetism as Required by the DepEd for the Whole Term

The findings reveal that the teachers included in this study had moderately covered to highly covered the learning competencies in Electricity and Magnetism as required by the DepEd for the whole term.

Table 14
Level of Extent of Coverage of Respondents on Learning Competencies in Electricity and Magnetism as required by the Department of Education for the Whole Term.

Level of Coverage	Electricity and Magnetism	
	f	**%**
Not at All (0)	1	2.9
Low Extent (1 – 25)	5	14.7
Moderate Extent (26 - 50)	14	41.2
High Extent (51 - 75)	14	41.2
Total	**34**	**100.0**

Coverage on Optics as Required by the DepEd for the Whole Term

The figures in Table 15 show that almost a quarter (23.5%) had not covered the required learning competencies required by the DepEd for the whole term. The proportion of teachers who had a low extent of covering fully the required topics may be attributed to their lack of preparation in teaching the subject and with physics background. As shown in the findings, most of the respondents were graduates of other fields and have a low level of knowledge in physics. Teachers who opted not to take up the required learning competencies in Optics showed that they are not confident to discuss the topics and they are not ready to teach the subject.

Table 15
Level of Extent of Coverage of Learning Competencies in Optics as required by the Department of Education for the Whole Term.

Level of Coverage	Optics	
	f	**%**
Not at All (0)	8	23.5
Low Extent (1 – 8)	2	5.9
Moderate Extent (9 – 17)	11	32.4
High Extent (18 – 26)	13	38.2
Total	**34**	**100.0**

Coverage in Modern Physics Concepts as Required by the DepEd for the Whole Term

Results show that only 8.8 percent of teachers had fully covered the required topics in Modern Physics, and the same proportion of teachers who had moderately covered (14.7%) and who had a low extent of covering fully (14.7%) the required learning competencies. It is surprising to know that more than more than 50% (61.8%) of the teachers had not covered the required learning competencies in Modern Physics for the whole term.

The high proportion of Senior High School Physics teachers who have not covered the required learning competencies in Modern Physics showed that teachers have a lack of understanding of the concept and principles of the subject and hence they failed to discuss it with their students. Moreover, the high proportion of teachers who failed to cover the required learning competencies by the DepEd showed that physics teachers are not ready to teach the subject.

Table 16
Level of Extent of Coverage of Respondents on Learning Competencies in Modern Physics as required by the Department of Education for the Whole Term.

Level of Coverage	Modern Physics	
	f	**%**
Not at All (0)	21	61.8
Low extent (1 -3)	5	14.7
Moderate Extent (4 – 6)	5	14.7
High Extent (7 – 9)	3	8.8
Total	**34**	**100.0**

Extent of Coverage of the Required Learning Competencies in terms of Professional Competencies

Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as required by the DepEd in terms of Highest Educational Attainment.

Electricity and Magnetism

Findings show that teachers who have Master's degree in teaching physics have a higher extent of covering fully the learning competencies in Electricity and Magnetism required by the DepEd than the teachers who were bachelor's degree graduates. This further shows that teachers who underwent advanced studies have better way of covering the required topics than bachelor's degree teachers. The findings of this study conform with the study conducted by Harris & Sass (2006) that teachers qualifications and educational background had effects in their performance.

Optics

The figures in Table 17 show that teachers with Master's degree majors in physics were found with a high extent of covering the required learning competencies in Optics, hence, they are ready to teach the subject. In other way around, higher percentage of teachers who were graduates of other fields have not covered the required learning competencies in Optics for the whole term compared to graduates of physics program. These teachers may have the difficulties of understanding the concept and principles in physics that made them hesitant to cover the required learning competencies and discuss it with their students. Further, the difficulties experienced by these teachers in analyzing and understanding the concept can be attributed by their lack of background information and experiences in dealing with the specific learning competencies. This finding also conforms with the result of the study of Harris & Sass (2006) that teachers qualifications and educational background had effects in their performance. Ingersoll, 1999 in his findings states that secondary school science teachers without full certification in teaching the subjects caused significant concern about the science and mathematics instruction children may or may not be receiving.

Modern Physics

Results of the survey show that teachers with advanced studies specifically in physics were moderately covered in the required learning competencies in Modern Physics compared to teachers with bachelor's degrees. The low coverage of teachers on the required topics in Modern Physics can be the result of their lack of knowledge about the subject which is attributed to their lack of professional competencies in terms of educational attainment, number of physics-related seminars attended, and length of experience in years in teaching physics. The decisions not to cover or having a low level of covering fully the learning competencies in physics as required by the DepEd showed that teachers were not ready to teach Modern Physics. This finding also proves the result of the study of Harris & Sass (2006) that teachers' qualifications and educational background had effects in their performance.

Table 17
Extent of Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as required by the DepEd in terms of Highest Educational Attainment.

Extent of Coverage of Learning Competencies	Highest Educational Attainment									
	Bachelor's degree (Other Fields)		Master's and Doctoral degrees (Other Fields)		Bachelor's degree Major in Physics)		Master's degree (Major in Physics)		Total	
	f	%	f	%	f	%	f	%	f	%
Electricity and Magnetism										
Low Extent	2	25.0	1	8.3	2	42.9	0	0	6	17.6
Moderate Extent	4	50.0	4	33.3	3	42.9	3	42.9	14	41.2
High Extent	2	25.0	7	58.3	1	14.3	4	57.1	14	41.2
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**
Optics										
Low Extent	5	62.5	2	16.6	3	42.9	0	0	10	28.5
Moderate Extent	0	0	5	41.7	4	57.1	2	28.6	11	32.4
High Extent	3	37.5	5	41.7	0	0	5	71.4	13	38.2
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**
Modern Physics										
Low Extent	7	87.5	8	66.7	5	100.0	4	75.1	26	76.5
Moderate Extent	0	0	2	16.7	0	0	3	42.9	5	14.7
High Extent	1	12.5	2	16.7	0	0	0	0	3	8.8
Total	**8**	**100.0**	**12**	**100.0**	**7**	**100.0**	**7**	**100.0**	**34**	**100.0**

Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as required by the DepEd in terms of Number of Physics-Related Seminars Attended

Electricity and Magnetism

Figures show that teachers who attended 3 or more physics-related seminars had the higher extent to fully cover topics in Electricity and Magnetism compared to other teachers who attended 2 or less seminars in physics. The figures also show that teachers who attended 3 or more physics-related seminars have the better way to manage how the required learning competencies are discussed to their students than teachers who had attended either 2 or 1 or never attended any physics-related seminars. Further, the teachers who have less attendance in any physics-related seminars had a low extent of covering the required learning competencies for the whole term, hence they considered not ready to teach the subject.

Optics

Findings reveal that teachers who attended physics-related seminars have a higher extent of covering fully the required learning competencies in Optics than teachers who never attended any seminars in physics. This shows that teachers who attended physics-related seminars have learned some techniques and strategies on how the required learning competencies be covered and discussed to students for the whole term compared to teachers who had not attended any physics seminars at all. Their attendance in any physics-related seminars can be opportunities to adopt some new techniques in teaching physics and develop confidence to discuss the topics to the students.

Modern Physics

Table 18 shows that higher proportion of teachers who have not attended any physics seminars (93.8%) have low extent any covering fully the required learning competencies in Modern Physics compared to teachers who have attended 3 or more physics-related seminars (75.0%), 1 physics-related seminar (63.5%), and 2 physics-related seminars (63.5%), respectively.

The higher percentage of teachers who did not cover the required learning competencies in Modern Physics may be due to their lack of knowledge about the subject which can be attributed to their lack of professional competencies. As noted, most of the teachers included in the study were graduates of other fields and have low levels of knowledge in physics. The low coverage of teachers on topics in Modern Physics also shows that teachers were not ready to teach the subject.

Table 18

Extent of Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as required by the DepEd in terms of Number of Physics-Related Seminars Attended.

Extent of Coverage of Learning Competencies	Number of Physics-Related Seminars Attended									
	Never Attended		1 Seminar		2 Seminars		3 or More Seminars		Total	
	f	%	f	%	f	%	f	%	f	%
Electricity and Magnetism										
Low Extent	5	31.0	1	9.1	0	0	0	0	6	17.6
Moderate Extent	7	43.8	4	36.4	2	66.7	1	25.0	14	41.2
High Extent	4	25.0	6	54.5	1	33.3	3	75.0	14	41.2
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**
Optics										
Low Extent	7	43.8	3	27.2	0	0	0	0	10	29.4
Moderate Extent	6	37.5	2	18.2	1	33.3	2	50.0	11	32.4
High Extent	3	18.8	6	54.5	2	66.7	2	50.0	13	38.2
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**
Modern Physics										
Low Extent	15	93.8	7	63.5	1	33.3	3	75.0	21	76.5
Moderate Extent	0	0	3	27.3	2	66.7	0	0	5	14.7
High Extent	1	6.3	1	9.1	0	0	1	25.0	3	8.8
Total	**16**	**100.0**	**11**	**100.0**	**3**	**100.0**	**4**	**100.0**	**34**	**100.0**

Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as Required by the DepEd in terms of Length of Experience in Years in Teaching Physics

Electricity and Magnetism

Higher proportion of teachers who had been teaching physics for 5 years or less (29.4 %) and teachers teaching physics for 6 – 10 years (14.3%) have low extent of covering fully the required learning competencies in Electricity and Magnetism for the whole term compared to the proportion of teachers who had been teaching physics for 11 years or more (0%).

Results further show that the high extent of fully covering the required learning competencies in Electricity and Magnetism by the teachers can be attributed by their teaching experiences and learnings gained from the time they have taught physics. The results of this study conform to the findings of Diamante (1997) that teachers with longer experience exhibit significantly better performance than those with shorter experience.

Optics

The findings reveal that there is a higher proportion (60%) of teachers who had been teaching physics for more than 10 years have fully covered the required learning competencies in Optics than the teachers who had been teaching physics for 6 -1 0 years (42.9%) and 5 years or less (23.5%). The figures also show that 42.9% of teachers who had been teaching physics for 6 - 10 years and 40.2% of teachers who had been teaching for 5 years or less had low extent of covering fully the required learning competencies in Optics for the whole term than the teachers who had been teaching physics for more than 10 years (0%).

Based on the findings, the high extent of teachers to fully cover the required learning competencies in Optics can be attributed by their high level of knowledge in the subject and the learnings they gained through their teaching experiences. Their teaching experiences and learnings gained can give them confidence in discussing the required learning competencies to the students. The results of this study also conform to the published statement of Herrera (1999) that there is strength of performance among experienced teachers with 5 – 10 years of length of service.

Modern Physics

The findings reveal that 20% of teachers who had been teaching physics for more than 10 years have high extent of covering fully the required learning competencies in

Modern Physics compared to teachers who had been teaching physics for 5 years or less (5.9%) and teachers who had been teaching Modern Physics for 6 – 10 years (0%). In contrast, very high proportions of teachers teaching physics for 6 – 10 years (85.7%) and 5 years or less (82.3%) have low extent of covering fully the learning competencies in Modern Physics required by the DepEd than the proportion of teachers who had been teaching physics for 11 years or more (60.0%).

The high proportion of respondents who have not covered fully the required learning competencies can be attributed by their lack of knowledge about the subject and the strategies on how the topics are to be presented to the students. The lack of professional competencies and difficulties to identify methods to present the subject to the students can be some factors that hinder physics teachers from discussing the required learning competencies. The results of this study also conform to the findings of Diamante (1997) that teachers with longer experience exhibit significantly better performance than those with shorter experience. Herrera (1999) also published that there is strength of performance among experienced teachers with 5 – 10 years of length of service; while Lopez (1999) found out that more experienced teachers were rated higher than those with shorter teaching experience.

Table 19

Extent of Coverage of Learning Competencies in Electricity and Magnetism, Optics and Modern Physics as Required by the DepEd in terms of Length of Experience in Years in Teaching Physics.

Extent of Coverage of Learning Competencies	Length of Experience in Years in Teaching Physics							
	5 Years and Below		6 – 10 Years		11 Years or More		Total	
	f	%	f	%	f	%	f	%
Electricity and Magnetism								
Low Extent	5	29.4	1	14.3	0	0	6	17.6
Moderate Extent	7	41.2	4	57.1	3	30.0	14	41.2
High Extent	5	29.4	2	28.6	7	70.0	14	41.2
Total	**17**	**100.0**	**7**	**100.0**	**10**	**100.0**	**34**	**100.0**
Optics								
Low Extent	7	40.2	3	42.9	0	0	10	29.4
Moderate Extent	6	35.3	1	14.3	4	40.0	11	32.4
High Extent	4	23.5	3	42.9	6	60.0	13	38.2
Total	**17**	**100.0**	**7**	**100.0**	**10**	**100.0**	**34**	**100.0**
Modern Physics								
Low Extent	14	82.3	6	85.7	6	60.0	26	76.5
Moderate Extent	2	11.8	1	14.3	2	20.0	5	14.7
High Extent	1	5.9	0	0	2	20.0	3	8.8
Total	**17**	**100.0**	**7**	**100.0**	**10**	**100.0**	**34**	**100.0**

Rationale in Designing and Developing a Module for Senior High School Physics Teachers

This module was developed based on the result of the assessment conducted on the readiness on Senior High School Physics teachers in terms of their level of knowledge in Physics covering the areas in Electricity and Magnetism, Optics and Modern Physics when classified according to their highest educational attainment, number of years in teaching Physics, number of Physics-related seminars attended, number of hours and name of Physics-related seminars attended. Assessments were also conducted to determine their readiness based on their interest in teaching the subject, their teaching approaches or strategies, and their extent of coverage on the learning competencies in Physics as required by the Department of Education.

Assessment on the Readiness of Senior High School Physics Teachers in Teaching Physics

Based on the result of the assessment conducted on the readiness of Senior High School physics teachers in teaching physics, most of the teachers were not graduates of physics program but of other fields, teaching physics for 5 years and below, and majority have not attended physics-related seminars. In addition, when readiness of Senior High School physics teachers included in the study in terms of their content knowledge in physics were assessed, findings showed that Senior High School physics teachers have low level of knowledge in Electricity and Magnetism, and Modern physics but found to have high level knowledge in Optics. Specifically, teachers have low percentage of having the correct answers for the examination given focusing on Electromagnetism.

When the level of extent of coverage on the learning competencies in physics as required by the Department of Education in the areas (a) Electricity and Magnetism, (b) Optics, and (c) Modern Physics were determined, results also showed that higher proportion of Senior High School Physics teachers were not able to cover fully the learning competencies required in physics.

Generally, when the readiness of Senior High School physics teachers in teaching Physics in terms of their professional competencies were determined, results showed that higher proportion of physics teachers were not graduates of physics program, have less experience in teaching physics, have low level of knowledge in physics in the areas of Electricity and Magnetism, and Modern Physics, and have not covered fully the learning competencies in physics required by the Department of Education. This shows that Senior High School physics teacher were more not ready to teach Physics.

From the result of this assessment, the researcher decided to design, develop and evaluate a module in physics as an instructional material for Senior High School physics teachers to serve as additional references for their knowledge and served as guide for these teachers on how to impart the concept, principles and theories of physics to their students in a simple and effective way.

Designing Instructional Module for Senior High School Physics Teachers

After conducting an assessment on areas where physics teachers were found weak, specifically in level of content knowledge in physics, a module was designed to fit the needs of the teachers. The discussion below showed the designing of a module for Senior High School physics teachers.

The readiness of Senior High School physics teachers in terms of content knowledge on topics in physics specifically on the areas Electricity and Magnetism, Optics and Modern Physics were determined according to their highest educational attainment, number of physics-related seminars attended, number of years in teaching physics, and teaching approaches/methods used in teaching Physics. This was conducted to assess what area or areas do Senior High School physics teachers observed weak and more likely not ready to teach physics. The gathered information was used to design a module that fits the need of Senior High School physics teachers and improved their competencies in teaching the subject.

Based on the findings of the assessment, there was a need to design and develop a module that required. The following are the design of the module:

(a) Overview of the Module. This gives Senior High School physics teachers a bird's eye view of the module, and instruction on how to use the module. The overview of the module can also motivate them to study each lesson in each module.

(b) Objectives of the Module: These are specific topic/s included in the module for Senior High School physics teachers to be guided. These may be the specific competencies that the teachers should impart to students in acquiring knowledge for each lesson.

(c) Background Information for Teachers. Background information about the topic, specific lessons for discussions, figures or diagrams for the teachers to relate applications and uses of every term and specific examples to apply concepts and principles in everyday lives that are aligned with the learning objectives of the module were included. This will serve as references and additional information of Senior High School physics teachers for any inquiries being done during the lectures and discussions. Diagrams were also included for the teachers to picture out how things happened and how it will be conducted. Each sub-topic in the background information was labeled for Senior High School Physics teachers to be guided.

(d) Demonstration Activity. This may be a simple activity to be conducted by Senior High School physics teachers before the class prepares the students and motivate them to participate in the lecture and discussion. Materials needed in the demonstration were also included for advance preparation.

(e) Strategies for Evaluation. Simple problem solving and guide questions were included for Senior High School physics teachers to review concepts and procedures learned in the discussions. This will also guide teachers to assess whether the learned during the discussions and whether the lessons discussed have been imparted successfully to students.

(f) Lesson development (Concept Map). These are structured in a manner that will guide Senior High School physics teachers in facilitating the student's understanding of the lesson. It was also believed that this concept map will help Senior High School Physics teachers facilitate teaching procedures and will guide them to identify their teaching strategies in teaching the subject.

(g) Questions and Sample Problems. This included guided questions and problem solving as evaluative measures to guide teachers in testing student's learning about the specific topic included in the module.

(h) Answer Keys for Questions and Problem Solving. Answer keys for all questions and problem solving included in the practice tasks will be presented for the teachers to check answers from the questions given in the practice tasks.

(i) References. These were sources of information to be used by Senior High School Physics teachers in checking some terms and questions for assignments.

Developing Instructional Modules for Senior High School Physics Teachers

After conducting an assessment on the weakness of Senior High School physics teachers in teaching, the Physics module was designed to fit the needs of the teachers.

As discussed earlier, the module was being designed which included, (a) Overview of the Module, (b) Specific objectives, (c) Background Information for Teachers, (d) Demonstration Activity, (e) Strategies for Evaluation, (f) Lesson development (Concept Map), (g) Questions and Sample Problems, (h) Answer Keys for Questions and Problem Solving, and (i) References. The output of the developed modules based on the assessment conducted and the design was presented in the Appendix.

Implementation of the Module to Senior High School Students

The developed module was tested on its effectiveness and efficiency by implementing it to the students in one of the DepEd Public schools in the Province of Iloilo. Pretest-posttest was conducted to two sections of the Senior High School STEM program students. One section was assigned as the controlled group and the other section was assigned as the experimental group. The controlled group used the traditional lecture-discussion method in teaching Electromagnetism and the experimental group used the developed module in teaching Electromagnetism.

Difference in the Performance of Students before the Use of Module and Traditional Lecture-Discussion Method in Teaching Electromagnetism

The results of the test for the difference in the performance of students before the use of Module and the use of traditional lecture-discussion were presented in Table 20. Findings showed that the mean performance of the students in the controlled group before the use of traditional lecture-discussion method in teaching Electromagnetism was 14.29 and the mean performance of students in the experimental group before the use of Module in teaching Electromagnetism was 13.25. Based on the findings, the difference in means of 1.04 was not significant at .05 level of significance as shown by the t-value of 1.04 and p-value of .286. This implies that the performance of students in the controlled group does not vary with the performance of students in the experimental group before the treatment.

Table 20

Difference in the Performance of Students Who Belong to the Control Group and Experimental Group before the Use of Module and Traditional Lecture-Discussion Method in Teaching Electromagnetism.

Before the Treatment	Performance of Students					
	N	Mean	sd	Mean Difference	t-value	p-value
Controlled Group	28	14.29	3.0616	1.04	1.130	.286
Experimental Group	28	13.25	3.4386			

Difference in the Performance of Students Who Belong to the Control Group before and After the Use of Traditional Lecture-Discussion in Teaching Electromagnetism

As discussed previously, students who belong to the controlled group in this study were students who were taught the lecture-discussion method in teaching Electromagnetism.

Table 21 shows the result of the test on the difference in the performance of students who belong to the controlled group. The data revealed that, the mean performance of students who belonged to the controlled group before the use of traditional lecture-discussion method in teaching Electromagnetism was 14.29 while the performance of the students who belonged to the controlled group after the use lecture-discussion method in teaching Electromagnetism was 16.46. Based on the findings, the difference of 2.17 was significant at .05 level as shown by the t-value of 4.193 and the p-value of .000. This implies that the performance of students after the use of lecture-discussion method in teaching Electromagnetism varies with their performance before the use of lecture-discussion method in teaching Electromagnetism.

Table 21

Difference in the Performance of Students Who Belong to the Control Group before and After the Use of Traditional Lecture-Discussion in Teaching Electromagnetism.

Control Group	Performance of Students					
	N	Mean	sd	Mean Difference	t-value	p-value
Before the Treatment	28	14.29	3.0167	2.17	4.193*	.000
After the Treatment	28	16.46	2.2191			

**Significant at .05*

Difference in the Performance of Students Who Belong to the Experimental Group before and After the Use of Modules in Teaching Electromagnetism.

Table 22 shows the difference in the performance of students who belong to the experimental group before and after the use of Module in teaching Electromagnetism. Findings revealed that the mean performance of students who belonged to the experimental group before the use Modules in teaching Electromagnetism was 13.25 and their mean performance after the use of Module in teaching electromagnetism was 19.75. Based on the results, the difference in mean of 6.50 was significant at .05 level as shown by the t-value of 8.099 and p-value of .000. This implies that the performance of students in Electromagnetism who belonged to the experimental group before the use of Module varies with their performance in Electromagnetism after using the module.

Table 22
Difference in the Performance of Students Who Belong to the Experimental Group before and After the Use of Module in Teaching Electromagnetism.

Experimental Group	Performance of Students					
	N	Mean	sd	Mean Difference	t-value	p-value
Before the Treatment	28	13.25	3.4386	6.50	8.099*	.000
After the Treatment	28	19.75	4.1778			

**Significant at .05*

Difference in the Performance of Students after the Use of Traditional Lecture-Discussion Method and Use of Module in Teaching Electromagnetism

Table 23 shows the difference in the performance of students who belong to the controlled group after the use of traditional lecture discussion method and who belong to the experimental group using Module in teaching Electromagnetism. Findings revealed that the mean performance of students who belonged to the controlled group was 16.46 while the mean performance of students using Module in teaching electromagnetism was 19.75. Based on the results, the difference in mean of 3.29 is significant at .05 level as shown by the t-value of 3.841 and p-value of .002. This implies that the performance of students in Electromagnetism who belonged to the experimental group using Module vary significantly with the performance of students in the controlled group after the use of traditional lecture-discussion method in teaching Electromagnetism. This implies that students who were using the module performed better than those students who were being taught using traditional lecture-discussion methods on the topic Electromagnetism.

Table 23
Difference in the Performance of Students Who Belong to the Experimental Group before and After the Use of Module in Teaching Electromagnetism.

Experimental Group	Performance of Students					
	N	Mean	sd	Mean Difference	t-value	p-value
Before the Treatment	28	16.46	2.2191	3.29	3.841*	.002
After the Treatment	28	19.75	4.1778			

**Significant at .05*

Difference in the Change in Mean Performance of Students after the Use of Module and Using Traditional Lecture-Discussion Method in Teaching Electromagnetism.

The results of the test for the difference in the change in mean performance of students after the use of Module and the use of traditional lecture-discussion in teaching Electromagnetism was presented in Table 24. Results showed that change in mean performance of students who belonged to the controlled group after the use of traditional Lecture-Discussion method in teaching Electromagnetism was 2.17 and the change in mean performance of students belonged to the experimental group after the use of Module in teaching Electromagnetism was 6.50. The difference in mean change performance of students was found significant at .05 level as shown by the t-value of 3.896 and p-value of .001. The result of the study implies that the performance of students in the experimental group using Module varies with the performance of students in the controlled group using the traditional Lecture-Discussion method in teaching Electromagnetism.

Table 24
Difference in the Change in Mean Performance of Students after the Use of Module and Traditional Lecture-Discussion Method in Teaching Electromagnetism.

After the Treatment	Performance of Students				
	N	Mean Difference	sd	t-value	p-value
Control Group	28	2.17	2.7495	3.896*	.001
Experimental Group	28	6.50	4.2470		

**Significant at .05*

Teachers' Evaluation (Respondents) Result of the Instructional Modules in Physics

In summary, based on the evaluation results by the Senior High School physics teachers evaluators, the newly developed module was rated excellently in terms of the objectives of the modules (M = 4.70) content of the Modules (M = 4.50) format and language of the modules (M = 4.45) presentation of the module (M = 4.28) and the usefulness of the module (M = 4.55).

The overall average rating of the Senior High School teachers on the newly prepared module in Physics was 4.50, and using the scale below it is described as excellent.

Table 25
Teachers-Respondents' Evaluation on Modules for Senior High School Physics Teachers.

Aspect of Instructional Module	Evaluation Responses of the Teachers		
	Mean	sd	***Description***
Objectives of the Modules	4.70	.485	*Excellent*
Content of the Modules	4.50	.552	*Excellent*
Format/layout and language of the Modules	4.45	.563	*Excellent*
Presentation of the Modules	4.28	.493	*Excellent*
Usefulness of the Modules	4.55	.528	*Excellent*
Overall Mean	**4.50**	**.524**	***Excellent***

Scale: Poor (1:00 – 1.80), Fair (1.81 – 2.60), Good (2.61 – 3.40), Very Good (3.41 – 4.20) Excellent (4.21 – 5.00)

Experts' Evaluation Results of the Instructional Modules in Physics

Based on the mean evaluation results by the experts, the newly developed module was excellent in terms of the objectives of the modules (M = 4.84), content of the modules (M = 4.25), format and language of the modules (M = 4.43), presentation of the module (M = 4.40), and the usefulness of the module (M = 4.60). The overall average rating of the experts on the prepared module in Electricity and Magnetism was 4.51, and using the scale below it was described as excellent.

Table 26
Experts' Evaluation Results on Modules for Senior High School Teachers.

Aspect of Instructional Module	Evaluation Responses of the Teachers		
	Mean	**sd**	***Description***
Objectives of the Modules	4.84	4.75	*Excellent*
Content of the Modules	4.25	.627	*Excellent*
Format/layout and language of the Modules	4.43	.604	*Excellent*
Presentation of the Modules	4.40	.671	*Excellent*
Usefulness of the Modules	4.60	.568	*Excellent*
Overall Mean	**4.51**	**.589**	***Excellent***

Scale: Poor (1:00 – 1.80), Fair (1.81 – 2.60), Good (2.61 – 3.40), Very Good (3.41 – 4.20) Excellent (4.21 – 5.00)

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Senior High School Physics teachers in the City and Province of Iloilo were dominated by graduates with Master's degrees in other fields, teaching physics for 5 years or less and have not attended any physics-related seminars.

2. Physics teachers were not very ready to teach physics. Most of the teachers included in the study still need to continue pursuing educational advancement in the area of physics, by either attending seminars, or upgrading their professional qualification and gaining more experience in teaching physics.

3. Physics teachers have low level of knowledge in Electricity and Magnetism and gained an average level of knowledge in Optics and Modern Physics.

4. There was a high proportion of teachers with high level of knowledge in Electricity and Magnetism, Optics and Modern Physics who were graduates of physics programs rather than teachers who graduated from other fields.

5. The proportion of teachers who attended 2 or more physics-related seminars with a high level of knowledge in Electricity and Magnetism, Optics and Modern Physics was higher than the proportion of teachers who attended at least 1 seminar in physics and those who never attended any physics-related seminars.

6. There is a higher proportion of teachers who had been teaching physics for 16 years or more with a higher level of knowledge in Electricity and Magnetism and Modern Physics than teachers who had been teaching physics for less than 15 years.

7. Teachers preferred to use lecture/discussion with interactive demonstration (cooperative learning, experimentation, problem solving, hands-on activity) in teaching Physics.

8. Physics teachers had moderately to highly extent of covering fully the required learning competencies in Electricity and Magnetism and Optics but low extent in covering fully the learning competencies in Modern Physics.

9. Teachers with Master's degree have higher extent of covering fully the learning competencies in Electricity and Magnetism and Optics but low in Modern Physics than teachers with bachelor's degree. Teachers who were graduates of bachelor degree have low extent of covering the learning competencies in Electricity and Magnetism, Optics and Modern Physics.

10. Teachers who had attended 3 or more physics-related seminars have higher extent of covering fully the learning competencies in Electricity and Magnetism, Optics and Modern Physics than teachers who had attended less number of seminars and never attended any seminars in physics.

11. The proportion of physics teachers who had been teaching physics for more than 10 years have a higher extent of covering the required learning competencies in Electricity and Magnetism, Optics and Modern Physics than teachers with less number of years teaching experience.

12. There is a need to design, develop and evaluate module in physics for Senior High School physics teachers.

13. The mean performance of students in the controlled group does not vary with the mean performance of students in the experimental group before the treatment.

14. The mean performance of students before the use of lecture-discussion method in teaching Electromagnetism varies with their mean performance after the use of lecture-discussion method in teaching Electromagnetism.

15. The mean performance of students before the use of Module varies with their performance after the use Module in teaching Electromagnetism.

16. The mean performance of students who belong to the control group after the use of lecture-discussion method varies with the mean performance of students belonging to the experimental group after the use of Module in teaching Electromagnetism.

17. The change in mean performance of students who belonged to the controlled group after the use of traditional lecture-discussion method varies with the mean performance of students belonging to the experimental group after the use of Module in teaching Electromagnetism.

18. The developed modules were rated by Experts and Physics teachers excellent in terms of the objectives of the module, content of the module, format and language of the module, presentation of the module, and usefulness of the module.

19. The developed modules showed potential as an effective instructional material in improving the quality of instruction in improving students' performances in Physics. The developed modules also showed potential in terms of its usage as evaluated by the experts and Physics teachers who were identified as the end users.

Recommendations

1. The Department of Education and School Administrators must be strict in implementing guidelines and requirements in hiring Physics teachers. If there was a shortage of Physics teachers, Schools' Administrators should create programs to align non-Physics graduates to teach Physics through Faculty Development programs or other forms of scholarships. It is also recommended that Department of Education officers and School's Administrators must be supportive of sending Physics teachers to any Physics-related seminars for them to learn and adopt the new methods and effective techniques in teaching Physics. Attending seminars and conventions may also be an avenue for Physics teachers to abreast with modern technology as an effective way of teaching Physics.

2. Physics teachers must be more diligent in improving their knowledge in Physics and continue improving their academic status to acquire more

knowledge, improving skills in analysis and understanding of concepts and principles in Physics by attending classes through graduate programs.

3. The low level of covering fully lessons in Physics based on the required DepEd Physics learning competencies in the areas of Electricity and Magnetism, Optics and Modern Physics may be attributed by the background information of the respondents included in the study. Based on the findings, a higher proportion of the Senior High School Physics teachers graduated with the degree major in other fields, teaching Physics for less than 5 years, and never attended any Physics-related seminars. Their lack of professional competencies may be attribute to their lack of background knowledge, understanding about the principles and concepts involved and the process on how the topics will be presented that made physics teachers decide not to discuss it with their students. It is therefore recommended that the Department of Education should conduct an enhancement activity to train and develop the competencies and ability of teachers who experienced difficulties in teaching the subject. It is further recommended that school's administrators must be supportive in enhancing the abilities and competencies of their physics teachers.

4. Teachers were found to have a low level of covering fully the lessons in Physics based on DepEd required learning competencies. This may be due to additional loads and assignments given to Senior High School Physics teachers such as advisers, coaches, events' facilitators that forced them skip classes and missed scheduled for the lectures as revealed by the respondents. It is recommended that school's administrators must be fair in giving assignments or additional loads to teachers not to sacrifice the need of the students to learn. It is further recommended that teachers must also know how to manage their time not to sacrifice scheduled classes in lieu of other activities inside and outside the school.

5. From the findings revealed, most Senior High School physics teachers lack of professional competencies and have a low level of knowledge in Electricity and Magnetism, Optics and Modern Physics. It is recommended therefore that an instructional material in the form of a module must be designed, developed and evaluated as a source of information and guide for teachers in introducing concepts and principles of physics to their students in a simple but effective way. The developed module can also be a material to enhance the extent of covering for all

the learning competencies required by the Department of Education during the term due to some additional loads and assignments assigned to them.

6. The developed module was rated excellent and demonstrates for its potential as an effective instructional material in improving students' performances. It is recommended that this developed module will be used by Senior High School physics teachers as their guide and reference of information to discuss topics in physics and as instructional material to improve their quality of teaching. It is also recommended that this module will be used by Senior High School physics teachers as instructional material to improve the performance of Grade 12 students in Physics.

7. It is further recommended that this study will be replicated using different topics in Physics and evaluated among teachers and students to further support the findings of this study.

REFERENCES

Abraham, K., & Morrison, K. (2006). Measuring and targeting internal conditions for school effectiveness in the Free State of South Africa. *Educational Management Administration and Leadership*, 34 (1), 30- 47.

Bonney, E.A., Amoah, D.F., Micah, S.A., Ahiamenyo, C., & Lemaire, M.B. (2015). The relationship between the quality of teachers and pupils academic performance in the STMA Junior High Schools of the Western Region of Ghana. *Journal of Education and Practice*. 6(24)

Boyd, D., Lankford, H., Loeb, S., & Wyckoff, J. (2005). Explaining the short careers of high achieving teachers in schools with low performing students. American Economic Review, 95(*2*) pp.166-71 Brophy, J., & Good, T. L. (1986), *Handbook of research on teaching* (pp. 340–370). New York, NY: Macmillan Library.

Chung, R., Frelow, F., & Darling-Hammond, L. (2002). Variation in teacher preparation: how well do different pathways prepare teachers to teach? *Journal of Teacher Education*, 53(*4*), 286-302. Education Policy Analysis Archives 7(9): 1-19.

Darling–Hammond, L. (2000). Teacher quality and student achievement: A review of state policy evidence. *Educational Policy Analysis Archives*, 8 (*1*).

Diamante, A. L. (1997). *Correlates of teaching performance among the faculty of West Visayas State University*. Unpublished doctoral dissertation, West Visayas University, Iloilo City.

Harris, D. N. & Sass, T. R. (2008). Teacher training, teacher quality and student achievement. || Working paper No.3 Washington, DC: Centre for The Analysis of Longitudinal Data in Education Research. (CALDER).

Ingersoll, R.M. (1999). "The problem of underqualified teachers in American secondary schools." *Educational Researcher* 28(*2*): 26-37.

Kurt, S. (2015) "Educational technology: An overview," in *Educational Technology*, https://educationaltechnology.net/educational-technology-an-overview/

Owolabi, S. O. (2007). Teacher education in sub- Saharan Africa: Policies and practices. Paper presented at the Development of Teacher Education in Africa Conference. Makarere University, Kampala, Uganda. August 4-6.

Rosenholtz, S. J. (1986). The organizational content of teaching in learning. University of Illinois at Champaign.

Saglam, H. (2011). An investigation on teaching materials used in social studies. *Turkish Online Journal of Educational Technology*. 10. 36-44.

Sulaiman, T., Hamzah, S. N. & Abdul Rahim, S. S. (2017). The relationship between readiness and teachers' competency towards creativity in teaching among trainee teachers. *International Journal of Social Science and Humanity*, 7(*8*).