Lux Veritatis 5: 18-33, 2020

ISSN no: 2476-5644

DEVELOPMENT, VALIDATION, AND IMPLEMENTATION OF DIFFERENTIATED LESSONS IN GRADE 7 PHYSICS USING MULTIMEDIA

Joyce B. Bondocoy, MAEd
Bicol University

ABSTRACT. The use of technology in education is undeniably becoming the trend in 21st century learning. With the integration of technology in education, the way how teachers present and transmit information and the way how students gather and interpret them has revolutionized. With this advancement, effectiveness and efficiency on both the part of students and teachers are expected to improve. This study aimed to develop, validate, and implement differentiated lessons in Grade 7 Physics using multimedia. Specifically, it aimed to develop differentiated lessons in Grade 7 Physics using multimedia considering the student's learning styles; determine the expert's assessment of the lessons; and determine its effects on the development of student's conceptual understanding, higher order thinking skills and attitude towards Physics. The study made use of pre-experimental one-group-pretest-posttest design with 42 students as respondents. Results showed that seven lessons were developed in Grade 7 Physics which had the following features: inquiry-based, contextualized, use of ICT and use of differentiation based on student's learning styles. The juror's assessment of differentiated lessons using multimedia obtained an overall descriptive rating of excellent and a mean rating of 4.72. The student's conceptual understanding improved with a mastery level (ML) percentage increase of 42.70%. The student's higher order thinking skills improved with an ML percentage increase of 28.83%. The lessons also resulted to an overall positive shift of 10.69 on student's attitude towards Physics. The effects on the conceptual understanding and attitude towards Physics of the three learning style groups were not statistically significantly different whereas the effects on the higher order thinking skills of the three groups were statistically significantly different.

KEYWORDS: *Differentiated lessons, multimedia, learning styles, Grade 7 Physics*

INTRODUCTION

The use of technology in education is undeniably becoming the trend in 21st century learning. With the integration of technology in education, the way how teachers present and transmit information as well as the way how students gather and interpret them has revolutionized. With this advancement, effectiveness and efficiency on both students and teachers are expected to improve.

One cannot downgrade the role that Science plays in today's technological society. With this in mind, Science education is placed on a pedestal. For the past years, the Philippines has always been on the tail end when it comes to Science education. However recently, the Philippines ranked 67th out of 140 in quality of Math and Science education in the 2015-2016 Global Competitiveness Report of the World Economic Forum and 79th of 138 in the 2016-2017 data (Dela Cruz, 2017). This slight improvement may be tracked down on the way the said subject is taught nowadays.

With the advent of technology, one of the visions of the K-12 Science Curriculum is to develop a technologically literate member of the society (K-12 Curriculum Science Guide, 2013). In schools, the most likely way to acquire technological literacy is to expose the students to technological concepts and hands-on, design related activities (Thomas, Cole, & Denton, 2002).

The said curriculum also highlights strategies which are anchored on different sound educational pedagogies. One of these pedagogies is the learning style theory (K-12 Curriculum Science Guide, 2013). Diversity among students is a common scenario in every classroom setting. Teaching diverse learners is one the most challenging tasks of a teacher. Learners learn differently, one mode of instruction is not enough to ensure that all the learners in the classroom were able to grasp what the teacher has taught. However, it is observed that in the Philippines, most of the teachers practice the whole-class approach where one lesson is designed to meet the needs of all the learners. These teachers think that they are using differentiation but in reality, they are not.

Differentiation, according to Tomlinson, is based on the proposition that learners learn best when their differences in their readiness levels, interest, and learning profiles are accommodated by their teachers (Subban, 2006). Differentiating on the basis of learning profiles, a teacher addresses learning styles, student talent, or intelligence profiles (Tomlinson & Allan, 2000). By attending to their individual needs, students

ISSN no: 2476-5644

were given the equal opportunity to learn the material presented to them.

These authors differentiated their instruction in terms of different factors such as students' readiness, interest or learning profile. For this study, the lessons are differentiated in terms of students' learning profiles specifically their learning styles. The learning style model that the researcher used is the VAK (Visual, Auditory and Kinesthetic) learning style. The VAK learning styles model suggests that most people can be divided into one of three preferred styles or modality of learning namely visual, auditory and kinesthetic learning styles (Chislett & Chapman, 2005). This has a significant impact on the student's ability to gather and interpret information that is why appropriate teaching strategies should be adapted.

Because of this idea of modality, selecting which instructional material to use is a crucial part in teaching-learning process. It has been recognized that the choice and use of appropriate instructional aid has a great impact on the attention, interest and participation of the learners. This may be quite a challenge for the teachers because in this generation, students tend to be easily distracted, bored and unmotivated. However, the choice of learning material may be the solution to these challenges. Providing them with wide array of learning modes will help them maximize their learning potentials.

The most effective and accessible way to address these kinds of learning differences is through multimedia. Multimedia principle states that people learn more deeply from words and pictures than from words alone (David, 2015). Gone are the days when learners heavily rely on the massive textbooks the teacher prescribed them to read. Today, learners are given the liberty to choose the material in which to gather information from. Internet provides a wide selection of educational sites as additional resources in understanding a particular subject matter. Some learners effectively retain the information presented to them if there are ample amount of illustrations, some prefers if it is in the form of a video, and others learn best if they are listening to a podcast.

In the classroom, one multimedia tool that teachers are utilizing to present their lessons is the Microsoft PowerPoint program. It provides the teachers the ability to equip their presentations with diverse types of media including pictures, sounds, animation and videos. This program allows teachers to present their lessons in a more dynamic way compared to lecture and chalkboard method (Hale, 2000).The use of PowerPoint presentations has become popular in classroom instruction because this is very accessible and easy to prepare.

The aforementioned premises provided the researcher the idea to pursue the present study which is intended for Physics subject. Among the branches of science, Physics is considered the most fundamental. It essentiality draws back to its attempts in describing the behavior of the smallest particles of matter, the universe and everything in between (Modini, 2005). However, despite the importance that Physics exhibits in our everyday lives, this subject poses a bad reputation to some. The students' negative beliefs and attitudes towards learning Physics are mainly because of the perceived complexity of the said subject because they are required to face different principles, formulas and various abstract concepts (Tural, 2015). Some students then are forced to dislike the subject because of this notion. In the research conducted by Barmby and Defty, Physics is perceived less favorably than the other science subjects, because pupils' expectations of success are less in Physics compared to biology or chemistry (Barmby & Defty, 2006). It is for this reason that the researcher wants to lessen this negative perception to this subject.

Under the K-12 curriculum, Physics is taught to all year levels for one quarter, through the spiral progression approach in teaching Science. With this approach, it is important to strengthen the foundations of students in Physics and this may be done by giving quality instruction to Grade 7 students.

In a now digital world of education where almost all students own a gadget, the researcher's goal is to make use of this advantage in order to have a highly effective method of learning Physics. The learners of this generation spend most of their time on their gadgets that is why the best way to get to their hearts is through these kinds of devices. By conducting this study, the researcher wished to lessen the negative perceptions and misconceptions of students regarding the Physics subject by giving them the liberty to use their preferred modes of learning.

This study aimed to develop, validate, and implement differentiated lessons in Grade 7 Physics using multimedia. Specifically, it aimed to: (1) develop differentiated lessons using multimedia for Grade 7 Physics considering the student's learning styles; (2) determine the expert's assessment of the differentiated lessons using multimedia in terms of the following: (a) accuracy of content, (b) presence of features of inquiry-based learning, (c) contextualization, (d) technical aspects of multimedia, and (e) appropriateness of activities to students' learning styles; and (3) determine

ISSN no: 2476-5644

the effects of the use of differentiated lessons using multimedia in terms of the development of: (a) conceptual understanding, (b) higher order thinking skills, and (c) student's attitude towards Physics.

This study was conducted to Grade 7 students of Tabaco National High School (TNHS). TNHS is one of the schools in Albay province which is composed of great number of students with a total of 8747 students in Junior High School enrolled for school year 2018-2019. The Junior High school division of the said school is comprised with a range of 39-50 sections per grade level with two sections for the Science, Technology, Engineering, and Mathematics (STEM) Program, 36-45 sections for the K-12 Basic Education Program (BEP), and one to four sections for SPA and SPS program (TNHS-EMIS, 2018). Large class size, like the common problem in Philippine classroom, is also a scenario in this school with each classroom in the BEP comprising an average of 50 students. This may be one of the reasons why the school only got a total MPS of 50.96 and 45.30 for Science subject during the 2013-2014 National Achievement Test. On the NAT 2014-2015 data, there is a significant decrease on both results with the school having a total MPS of 44.30 and 40.32 for Science subject. On the basis of quarterly assessment for the school year 2017-2018, students only got a general average of 59 for all subject areas and 55 for Science subject (TNHS-EMIS, 2018).

The lessons developed only include the first two modules in Grade 7 Physics: Motion in One Dimension and Waves. The Microsoft PowerPoint was used as multimedia tool. Differentiation only took place on the Explore part where the basis were the students' learning styles. Although there are several classifications of student's learning styles, the researcher only based the differentiation on VAK Learning styles. In addition, the differentiated lessons using multimedia were assessed based only on the criteria set by the researcher.

This study will benefit directly or indirectly the students, Physics teachers, educational administrators, and future researchers. The use of this differentiated lessons using multimedia will develop the students' mastery level on selected topics in Grade 7 Physics. Through this, the students' individual needs are given much attention. This allows the learners to maximize their learning potentials by allowing them to use their preferred modes of learning. The teachers can also utilize the differentiated lessons using multimedia as instructional tool in teaching Physics by using differentiated instruction as strategy. Educational administrators can use the idea and result of this study as basis for developing new strategies in teaching. In addition, this study may also serve as additional source of information in innovating ways of presenting new technologies to learners of this generation. Through the results of this study, they can identify the preferences of the learners in terms of learning material and use this as their bases. Lastly, this can serve as reference to future researchers whose aim is to use technology in developing instructional material in Physics subject. Researchers who wish to employ differentiated instruction as learning strategy may also use this study as their reference.

REVIEW OF RELATED LITERATURE AND STUDIES

A number of studies which have close relevance to the present study were reviewed and presented below. These studies dealt with the development and use of instructional materials, use of multimedia in classroom, utilization of differentiated instruction as teaching strategy, assessing instructional materials, and determining the effects of an intervention.

Several studies have been made regarding differentiated instruction. Alondra (2015) determined the effect of differentiated instruction based on the different learning styles of students in their performance in Mathematics IV. The results of his study showed that the students exposed to differentiated instruction showed an edge in learning Mathematics than those in the control group which was exposed to traditional way of teaching. Scott (2012) also conducted a study to determine if differentiated instruction improved student growth in the elementary Mathematics classroom. This study concluded that differentiated instruction did not have an overall effectiveness at a significant level. Students with higher academic capabilities have benefited greatly from the opportunity to be challenged at a higher level while those with moderate ability did not.

The study of Peralta aimed to determine the effect of Differentiated Instruction in student learning outcomes in Grade 7 Science. The lessons employing differentiated instruction were classified for advanced, emergent and foundational students. The results of the study showed that the developed lessons enhanced the mastery level and the 21st century skills of the students specifically the learning skills, information, media and technology skills, and life skills (Peralta, 2017). Buban (2014) also anchored his study on differentiation theory of Dr. Carol Ann Tomlinson. The differentiated lessons for the grades V and VI multi-grade class resulted to the

ISSN no: 2476-5644

increase in the learners' English proficiency in grammar and reading comprehension.

Sionicio conducted a study to look into the effect of using innovative teaching strategies such as the use of multimedia in teaching Mathematics on the academic performance and interest of first year students. Her findings suggest that multimedia is an effective tool to boost the interest and involvement in, enjoyment of, and liking for Mathematics (Sionicio, 2011). Peña's study also aimed to enhance the competencies of Grade VI pupils in English by using multimedia technology. It was found out that the utilization of instructional English materials using multimedia significantly improve the academic performance of the Grade VI pupils (Peña, 2012). De Garcia developed eight technology-mediated lessons in teaching motion which were then evaluated by Science experts. The major findings of the study are the increase in the performance level of the pupils and the positive rise in the pupil's attitude towards Science (De Garcia, 2013).

Ocfemia (2016) developed and used of PowerQuest in teaching Genetics. The findings of her study revealed that the material was effective in the development of students' understanding of genetics concepts, inquiry and cooperative skills. Based from the students' responses, it was also noted that the use of PowerQuest in teaching Genetics increases their motivation to learn, makes the lesson easier to understand, and makes learning enjoyable and meaningful (Ocfemia, 2016).

Carascal also developed PowerPoint-based offline WebQuest in Grade 7 Biology. Based from the result of the study, it was concluded that the use of developed PowerPoint- based offline WebQuest in teaching Grade 7 Biology helped the students to easily understand the lesson and determine its relevance in real-life, gained the interest and motivation of the students, and promoted collaboration (Carascal, 2018).

The review of related literature and studies talks about the importance of developing and utilizing instructional materials as well as the use of differentiated instruction in teaching. There are previous studies which determined the effectiveness of differentiated instruction as instructional strategy. There are also several studies about the use of multimedia technology in teaching. However, there was no study developing lessons using multimedia specifically for Grade 7 Physics. Furthermore, none of the studies had used differentiated instruction as teaching strategy while using multimedia in developing lessons for Grade 7 Physics. As far as the reviewed literature and studies are concerned, this is the gap bridged by the study.

Conceptual Framework

Appropriate choice and use of teaching strategy and instructional material go hand in hand in every teaching endeavor. The review of related literature and studies proved that the correct treatment of instructional material and appropriate choice of teaching strategy has significant effect on knowledge and skills acquisition as well as the learner's attitude towards learning in different areas of study. Likewise, addressing student's needs by means of differentiating instruction has a great promise for better student learning. Because of this, the researcher addressed the need of developing and utilizing more meaningful and personalized instructional tool that will pay attention to these learning differences.

In figure 1, the conceptual paradigm of the study is summarized. It is shown there that the researcher developed differentiated lessons in Grade 7 Physics using multimedia. This utilized Microsoft PowerPoint program as multimedia tool which consists of audio, video, pictures, texts and interactive objects. Differentiation only took place on the explore part of the lesson plan which has its counterpart on the developed material namely the "activity" part. Activities were differentiated based on students' learning styles specifically classified as VAK Learning styles. The VAK questionnaire was used to determine the dominant learning styles of the students. The lessons developed included topics in Grade 7 Physics namely: Motion in one dimension and Waves.

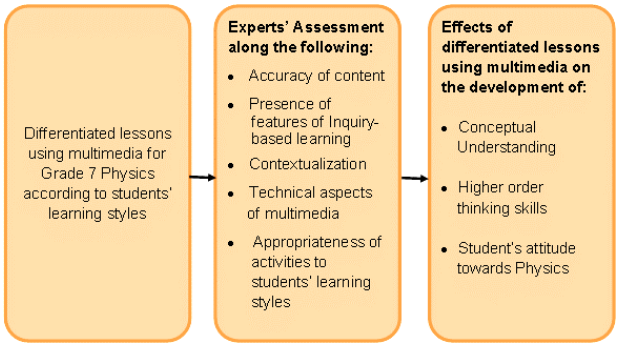

Figure 1. Conceptual Paradigm

The said material was assessed by the experts along the following features: accuracy of content, presence of features of inquiry-based learning, contextualization, technical aspects of multimedia, and appropriateness of activities to students' learning styles. A juror's assessment tool was given to the experts who were chosen based on their educational attainment,

ISSN no: 2476-5644

position, experience and expertise on the subject matter. The jurors gave their quantitative and qualitative assessment on the developed differentiated lessons in Grade 7 Physics using multimedia.

After the assessment of the differentiated lessons using multimedia, the researcher tested its effects in teaching Grade 7 Physics. Specifically, the study determined its effects in developing the students' conceptual understanding, higher order thinking skills, and attitude towards Physics. Pretest and posttest to determine the effects of the material on both the students' conceptual understanding and higher order thinking skills were administered to the students. On the other hand, attitude checklists and journal entries were utilized to determine its effectiveness in developing students' attitude towards Physics. A teacher observer also gave her observation on the actual conduct of the study.

METHODS

Research Methods

Descriptive research method was utilized to gather the necessary data needed for the study. This was used to describe the developed differentiated lessons using multimedia for Grade 7 Physics according to student's learning styles, the expert's assessment of the differentiated lessons using multimedia, and its effects on the development of student's conceptual understanding, higher order thinking skills and attitude towards Physics.

In terms of design, pre-experimental one-group-pretest-posttest design was used for the data gathering procedure. Pre-experimental design, according to Hefner (2004) as cited by Asagra obeys basic experimental steps but does not include a control group (Asagra, 2009). This included only one group of respondents where pretest on the specified competencies in Grade 7 Physics was given to the students to serve as baseline scores. A group of Grade 7 students served as respondents to measure the effects of the differentiated lessons using multimedia in developing students' conceptual understanding, higher order thinking skills, and attitude towards Physics.

Pretest and posttest were administered. The difference between the percentages in terms of Mastery Level of the students in the tests served as a change or gain in the performance of the students using the differentiated lessons in Grade 7 Physics using multimedia.

Respondents

The respondents of the study are the jurors who assessed the developed material, the Grade 7 students of Tabaco National High School, and the teacher-observer.

Jurors. They are composed of seven experts who assessed the developed differentiated lessons using multimedia. Purposive sampling was used to determine the jurors who will be part of this study. They are chosen according to their qualifications in terms of educational attainment, experience, and expertise on the said subject. The seven (7) experts were composed of: one head teacher III; one graduate of MA in Physics Education and is a PhD in Educational Foundations; one graduate of MST Physics and an instructor; and four graduates of MA in Physics Education.

Grade 7 students. Aside from the jurors, other respondents of this study were the forty-two (42) Grade 7 students of Tabaco National High School. One section from the K-12 Basic Education Program (BEP) of the said school was exposed to the use of the differentiated lessons using multimedia. This was the section assigned to the researcher by the cooperating school. Their attitude towards Physics, conceptual understanding and higher order thinking skills were analyzed and treated.

Teacher observer. The cooperating teacher was asked to observe the class while the researcher was implementing the differentiated lessons using multimedia in teaching the selected topics in Grade 7 Physics. The responses of the teacher observer served as qualitative basis on the effect of the intervention in the teaching-learning process.

Instruments

The main goal of the present study was to develop and utilize the differentiated lessons in Grade 7 Physics using multimedia to help the students develop their conceptual understanding on the said subject, their higher order thinking skills, and their positive attitude towards Physics. The researcher used the following instruments to gather the needed data:

Juror's assessment tool. This focused on determining the acceptability of the material developed in terms of the following criteria: (a) accuracy of content, (b) presence of features of inquiry-based learning, (c) contextualization, (d) technical aspects of multimedia, and (e) appropriateness of activities to students' learning styles. Indicators for each criterion were stated and a five-point scale was used to indicate the assessment/acceptability of the intervention.

ISSN no: 2476-5644

Conceptual understanding test. A parallel 40-item pretest and posttest was used to gather data for the assessment of students' conceptual understanding on the specified competencies.

Higher order thinking skills (HOTS) test. A 20-item multiple-choice HOTS pretest and posttest was used by the researcher to determine the effects of the differentiated lessons using multimedia on the development of students' higher order thinking skills. This is a multiple-choice test in which the items are categorized under the HOTS-analyzing and evaluating.

Students' attitude Checklist. The study employed the standardized attitude survey known as the Colorado Learning Attitude about Science Survey (CLASS). This consists of 42 statements where the student will respond using a five-point scale that ranges from strongly disagree (1) to strongly agree (5).

Students' Journal Entry. The students' journal entry served as an additional tool to support the data on students' conceptual understanding and attitude towards Physics. This included questions about their feelings and experiences during the actual conduct of the study.

Observation guide. This instrument was used to determine the strengths and weaknesses of utilizing the differentiated lessons in Grade 7 Physics using multimedia during the teaching-learning process. The cooperating teacher was guided by questions from the observation guide to describe what transpired during the conduct of the study. The observer was also asked to identify the good points observed and the areas for improvement.

VAK learning styles self-assessment questionnaire. This was adapted and used to determine the preferences of the students in terms of the learning styles—visual, auditory and kinesthetic. The VAK learning styles self-assessment questionnaire was downloaded from the website of Chislett MSc and A Chapman (2005) with the permission of the author. This was used to determine the dominant learning styles of the students which will determine their groupings.

Data Gathering Procedures

Prior to this, the researcher sought permission from the Schools Division Superintendent of Tabaco City and the Principal of Tabaco National High School to allow her to conduct the study to one class in Grade 7. The data gathering procedure included the following phases:

Lesson Development and Validation. The Differentiated lessons in Grade 7 Physics using multimedia as well as the lesson plan for each topic were developed. The lessons developed included the following modules in Grade 7 Physics: Motion in One Dimension and Waves. The researcher developed the differentiated lessons using multimedia and lesson plans for the following topics: (1) Position and Point of Reference; (2) Distance and Displacement; (3) Speed and Velocity; (4) Acceleration; (5) Longitudinal and Transverse waves; (6) Characteristics of waves; and (7) Mechanical and Electromagnetic waves. The lesson plan followed the 7E (Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend) model. Although the lesson plans were based on this model, the developed material had a different format namely (I) Overview, (II) Task, (III) Activity, (IV) Discussion (V) Evaluation, (VI) Conclusion, and (VII) Resources.

After the development of the lessons, a separate evaluation tool for lesson plan was used to determine its validity. The lesson plans were validated by the same experts who assessed the differentiated lessons using multimedia based on the following aspect: Objectives, learning content, differentiated activities, assessment and 7E's lesson proper. Suggestions and recommendations were considered to improve the lesson plans. The lesson plans received an over-all descriptive rating of excellent. Most of the recommendations of the experts focused on the objectives wherein it is said that the lesson objectives were highly focused on the cognitive domain.

Development of instruments used. The instruments used in the study were developed such as the juror's assessment tool, conceptual understanding and higher order thinking skills test, student's journal entry and observation guide. Other instruments were adopted from other sources and studies. The researcher adopted the VAK Learning styles self-assessment questionnaire from Chislett MSc and A Chapman (2005) to determine the students learning styles. Likewise, the Colorado Learning Attitude Science Survey was also adopted from Adams et. al. (2004) and was used to determine the student's attitude towards Physics.

Validation of the Instruments. The Physics experts were asked to validate the instruments used for the study. The said validators gave their rating on the instruments as well as comments and suggestions to further improve the instruments before using it in actual implementation.

a. Evaluation tool for the Conceptual Understanding and higher order thinking skills test. The researcher-made conceptual understanding test was validated by the experts based on the consistency of the items to the competency and its appropriateness to the level of cognition specified. Likewise, the HOTS test had undergone the same process of validation. Comments

ISSN no: 2476-5644

and suggestions to improve the test items was asked from the validators.

b. Pilot Testing. The researcher-made conceptual and HOTS test had undergone pilot testing first. This was administered to a Grade 8 class in Tabaco National High School. Item analysis was done to determine the good and poor items based on the result of the pilot testing. Difficulty index and discrimination index was computed to determine which items will be retained, revised or rejected.

The analysis of the test items used in this study resulted to ten (10) items being rejected in the conceptual understanding test while nine (9) items were rejected in the higher order thinking skills test. The researcher chose 40 items from the retained items in the conceptual understanding test and 20 items from the retained items in the higher order thinking skills based on the Table of Specifications.

Likewise, the Cronbach's alpha of the conceptual understanding test was 0.832 which indicates good reliability. The higher order thinking skills had a Cronbach alpha of 0.759 which indicates acceptable reliability. The tests were further subjected to validation of six experts. The data obtained from the experts in conceptual understanding test showed overall weighted mean of 4.87 on the consistency of items to competency and 4.96 on the appropriateness of the items to the level of cognition. Both ratings were considered outstanding. In the higher order thinking skills test, the data obtained showed overall weighted mean of 4.875 on the consistency of items to competency. This rating was also considered outstanding. Likewise, the said experts also evaluated the content validity of the test items. For this part, the data obtained for conceptual understanding test and inquiry skills test both showed an overall weighted mean of 4.52 which was interpreted as very evident.

Implementation. The dominant learning styles of the students were determined using the adopted VAK Learning styles self-assessment questionnaire. The result from the questionnaire showed that most students were visual learners with 21 students, 11 of them were auditory learners and 10 students were kinesthetic learners. The class was divided into four groups—two groups for visual, one group for auditory and another group for kinesthetic. This served as their permanent grouping throughout the conduct of the study.

The distribution of the validated pretest for conceptual understanding and HOTS test followed which was outlined from the competencies in the first two modules of Grade 7 Physics—Motion in One Dimension and Waves. Students were also asked to provide their responses on the CLASS to determine their initial attitude towards Physics. During the implementation, the researcher utilized the developed differentiated lessons using multimedia. The study was implemented for four weeks which is equivalent to 16 hours. The 7E learning model was employed in the presentation of the lesson.

The researcher utilized the multimedia on most parts of the lesson such as engage, explore, elaborate and evaluate. Differentiated instruction took place in the Explore part where there are three (3) different activities prepared. The students who were permanently grouped based on their learning styles performed the activities based on which group they belong. A student's journal sheet was distributed after the end of every lesson. The students then answered the guide questions specified in the journal. Moreover, an observation sheet was given to the cooperating teacher who served as the teacher-observer. The teacher-observer described what happened during the actual conduct of the study including the good points observed as well as the areas for improvement. The researcher also gave her observation.

After the four-week session, the posttest on conceptual understanding and HOTS parallel to the pretest was administered. The CLASS was once again given to the students to determine if there is a difference in their attitude towards Physics after utilizing the differentiated lessons using multimedia in the teaching process. The journals were also collected and considered.

Final Evaluation and Statistical Treatment. The juror's assessment of the developed differentiated lessons in Grade 7 Physics using multimedia were analyzed and treated. Likewise, the results gathered from the conceptual understanding test, HOTS test, and student's attitude checklist were put under statistical treatment to determine the effects of the differentiated lessons in Grade 7 Physics on the development of students' conceptual understanding, higher order thinking skills and attitude towards Physics. The responses from the journal entries of the students as well as the observations of the teacher observer were also analyzed to serve as qualitative basis.

The data gathered was tabulated and analyzed using mean, weighted mean, Cronbach's alpha, ANOVA, two sample t-test, mastery level percentage, and paired t-test.

a. Mean. This was used to express the mean score of the students in the pretest and posttest. This was also used to determine the evaluation of the jurors on the instruments which were used in the study.

ISSN no: 2476-5644

b. Weighted mean. This measure was used to average the experts' evaluation of the following features of the developed material: content, presence and features of inquiry-based learning, contextualization, technical aspects of multimedia, and appropriateness of activities to student's learning styles. This was also used for other instruments such as the evaluation tools for the instruments used.

c. Cronbach's alpha. Cronbach's alpha is a measure of internal consistency which is typically a measure based on the correlations between different items on the same test. It is considered to be a measure of scale reliability (Goforth, 2015). In this study, this was used to determine the reliability of the conceptual understanding and HOTS test.

d. One- way ANOVA (Analysis of Variance) is used to determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups (MacKenzie, 2018). This was used to determine the significant difference between the pretest results of the three learning style groups (Visual, Auditory and Kinesthetic) as well as their posttest results.

e. Two-sample t-test is applied to compare whether the average difference between two groups is significant. Two-sample t-test assuming equal variances was used to determine if there is a significant difference between the pretest as well as the posttest results of two groups (Visual vs Auditory, Visual vs Kinesthetic, and Auditory vs Kinesthetic).

f. Mastery level percentage determined the students' mastery in terms of conceptual understanding and higher order thinking skills. The mastery level interpretation used was based on the National Achievement Test Standards of the Department of Education (Fernandez, 2013).

g. Paired T-Test. This was used to determine the significant difference between the pretest and posttest result of the students' conceptual understanding and higher order thinking skills.

RESULTS AND DISCUSSION

The presentation, analysis and interpretation of data are arranged as follows: (1) Developed differentiated lessons in Grade 7 Physics using multimedia considering students' learning styles; (2) Expert's assessment in terms of accuracy of content, presence of features of inquiry-based learning, contextualization, technical aspects of multimedia, and appropriateness of activities to students' learning styles; and (3) Effects of the use of differentiated lessons using multimedia in terms of the development of conceptual understanding, higher order thinking skills and student's attitude towards Physics.

Developed Differentiated Lessons in Grade 7 Physics using Multimedia. Seven (7) differentiated lessons in Grade 7 Physics using multimedia were developed which had the following features—inquiry based, use of differentiation, use of ICT, and contextualized. The lessons are based on the competencies of the K to 12 Basic Education Curriculum of the Department of Education. The topics are under the content area on Energy in Motion which are the first two modules: Describing Motion and Waves around You. The lessons covered the topic on motion and waves intended for 16 hours or 4 weeks implementation.

The lessons are inquiry-based in nature following the mandate of the K-12 Science curriculum which is learner-centered and inquiry-based, emphasizing the use of evidence in constructing explanations (DepEd, 2016). To make the lessons inquiry-based, the researcher used the 7e's lesson proper: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, and Extend. Furthermore, features of inquiry-based learning like questioning and predicting, conducting investigations, processing and analyzing data, and communicating were used.

The lessons are differentiated based on student's learning profiles specifically their learning styles. The researcher employed the VAK learning style model which suggests that most people can be divided into one of three preferred styles of learning. In this study, the student's learning styles were considered by employing differentiation in the explore part of the lesson. Three sets of activities were prepared for visual, auditory and kinesthetic learners. The activities of visual learners included the following: drawing and referring to a diagram or illustration, plotting the map, actual observation of demonstration, and watching a video simulation. Auditory activities include recording a radio roleplay, listening to a recorded oral instruction, brainstorming, watching video lessons, and composing a song. The activities of kinesthetic learners include experimenting, performing tasks like running, walking, etc., actual demonstration, and playing a board game.

The lessons used ICT by utilizing multimedia on most parts of the lesson like engage, explore, elaborate, and evaluate. In the classroom setting, one of the most popular ways to present lessons in multimedia form is by using the Microsoft PowerPoint Program.

ISSN no: 2476-5644

The lessons were also contextualized by making the content relevant, meaningful and useful to the learners. Particularly, the researcher used the city of Tabaco as the main locale of the lessons. The places of Tabaco City as well as the local transportation *padyak* were featured in the lessons. Furthermore, contextualization was achieved by providing real-life applications which are familiar to the students.

The differentiated lessons using multimedia are researcher-made and had its own format namely: I. Overview; II. Task; III. Activity; IV. Discussion; V. Evaluation; VI. Conclusion; and VII. Resources. In the Overview part, the students were introduced to the situation or storyline. In here, the character of Teacher E (Einstein) introduced the topic through simple games using the PowerPoint as multimedia tool. In the task part, the essential question is presented. The students' job is to predict the answer to the question by brainstorming among their groupmates. The answer to this task question was revealed after the Activity part which is composed of three sets of activities for the three groups: Visual, Auditory and Kinesthetic group.

In the discussion part, the topic is discussed thoroughly with additional videos, illustrations, animations, and information from different sources. For the evaluation part, the questions range from multiple choice, true or false, problem solving, and enumeration. The next part is the conclusion in which the students are asked to reflect on what they have learned in the lesson. The references and websites where the videos, pictures and animations were taken are found in the resources part. The presentation of the lesson was limited only to Microsoft PowerPoint Presentation.

The seven lessons in Grade 7 Physics with the following features are: inquiry-based, contextualized, use of ICT and use of differentiation based on student's learning styles (Visual, Auditory and Kinesthetic) dealt on the following topics: position and point of reference, distance and displacement, speed and velocity, acceleration, transverse and longitudinal waves, characteristics of waves, and mechanical and electromagnetic waves.

Experts' assessment of differentiated lessons using multimedia. Delivering an effective education to all students is a shared responsibility. To achieve success, publishers, schools, and all levels of government must work together to ensure that every teacher and student has access to a range of high-quality instructional materials (Dohle, 2015). In this study, the experts assessed the developed differentiated lessons using multimedia which served as instructional tool in teaching Grade 7 Physics.

The said material was assessed by seven jurors along the following criteria: (a) accuracy of content; (b) presence of features of inquiry-based learning; (c) contextualization; (d) technical aspects of multimedia; and (e) appropriateness of activities based on students' learning styles. The jurors assessed the material by answering the researcher made Juror's Assessment tool on the developed differentiated lessons in Grade 7 Physics using multimedia.

Table 1 shows the summary of results of the juror's assessment of the developed differentiated lessons using multimedia. The jurors gave an excellent rating for the seven lessons along all the criteria: accuracy of content with a mean of 4.88, presence of features of inquiry-based learning with a mean of 4.61, Contextualization with a mean of 4.55, technical aspects of multimedia with a mean of 4.84, and appropriateness of activities to students' learning styles with a mean of 4.73. Overall, the developed lessons got a rating of 4.72 which also interpreted as excellent. This implies that the lessons developed excelled in terms of providing accurate content, the features of inquiry-based learning is present in the material, the lessons are contextualized by making the material meaningful to the learners, the material excelled in terms of its technical aspects, and the activities provided fit the learning styles specified. Although all the lessons received an excellent rating, revisions must still be made to improve the material. It was shown in the table that the differentiated lessons using multimedia got the highest rating on accuracy of content and lowest on contextualization.

This further implies that the lessons excelled in providing accurate, research-based and accurate information as well as clarity and correctness of Physics concepts. For this criterion, Lesson 4 got the highest rating which implies that this lesson provided the most accurate content among the other lessons. Furthermore, to improve the material in terms of the criterion contextualization, the concepts, examples, illustrations and activities must be enhanced based on students' experiences. Major revisions especially in Lessons 5-7 were done to address this criterion which can be seen in the final version of the differentiated lessons using multimedia.

For the lessons, Lesson 4 got the highest average rating of 4.90 (excellent) while Lesson 7 got the lowest rating of 4.59 (excellent). Lesson 4 got the highest rating because it excelled on all the criteria most especially in technical aspects of multimedia and

ISSN no: 2476-5644

accuracy of content. One juror commented that Lesson 4 was the most engaging lesson among the other lessons. Meanwhile, Lesson 7 got the lowest mean rating because the lessons are not highly contextualized compared to the other lessons. Additionally, some features of inquiry-based learning were not directly observed in the differentiated lessons using multimedia.

Table 1. *Summary ratings of juror's assessment of Differentiated lessons using multimedia*

Criteria	Mean Evaluation							Mean
	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	
Accuracy of Content	4.88	4.93	4.89	4.95	4.80	4.89	4.84	**4.88**
Presence of Features of Inquiry-based learning	4.61	4.71	4.82	4.89	4.48	4.39	4.39	**4.61**
Contextualization	4.66	4.79	4.63	4.77	4.43	4.34	4.21	**4.55**
Technical aspects of multimedia	4.83	4.68	4.88	4.98	4.73	4.85	4.93	**4.84**
Appropriateness of Activities to students' learning styles	4.73	4.84	4.89	4.89	4.61	4.57	4.59	**4.73**
Mean per lesson	**4.74**	**4.79**	**4.82**	**4.90**	**4.61**	**4.61**	**4.59**	**4.72**

Effects of the differentiated lessons using multimedia. The effects of the developed differentiated lessons in Grade 7 Physics using multimedia on conceptual understanding, higher order thinking skills and attitude towards Physics of students were evaluated quantitatively using the results of pretest-posttest on conceptual understanding test, HOTS test and CLASS. The effects were also supported by the teacher's observation, student's outputs and journals.

a. Conceptual Understanding. It is defined as the ability to grasp ideas in a transferrable way. It can help students to take what they learn in class and apply it across domains (Omari & Chen, 2016). In this study, the effects of the differentiated lessons using multimedia on the development of student's conceptual understanding was attained by obtaining a percentage increase in mastery level in terms of a 40-item multiple choice test which was administered before and after the implementation of the study.

Computing the mastery level (ML) is a measure which can determine the effects of the developed differentiated lessons in Grade 7 Physics using multimedia to student's conceptual understanding in which the results are reflected in Table 2. The obtained mastery level percentage was interpreted as:

ML Range	*Interpretation*
96-100	*M – mastered*
86-95	*CAM- closely approximating mastery*
66-85	*MTM- moving towards mastery*
35-65	*AM- Average mastery*
16-34	*LM- low mastery*
5-15	*VLM- very low mastery*
0-4	*ANM- absolutely no mastery*

Based from the results shown in the table, the student's conceptual understanding improved from low mastery (ML=25.58%) in the pretest to moving towards mastery (ML=68.27%) in the posttest which is equivalent to a percentage increase of 42.70%. To test the significant difference of this increase, p value can be computed by paired t-test. A p value lower than 0.05 means that the performance has significant difference, therefore, shows a gain while higher p value than 0.05 indicates no significant difference. The computed p value is 0.000 between pretest and posttest. This shows significant difference between the results of pretest and posttest. The difference in the ML between the pretest and posttest implies that the developed differentiated lessons using multimedia have effect on the development of student's conceptual understanding.

Using the ANOVA, the pretest and posttest results of the three learning style groups were analyzed to determine if there is a significant difference among the results. It was shown in the table that a p-value of 0.64 was obtained using the single factor ANOVA. To determine whether any of the differences between the means are statistically significant, the researcher compared the obtained p-value to the significance level of 0.05. If the P-value ≤ 0.05, the differences between some of the means are statistically significant. The obtained p-value means that there is no significant difference between the pretest results of the three learning style groups. Likewise, the posttest results between the three learning style groups was not significantly different as suggested by the obtained p-value of 0.89. This implies that although the mastery level percentage increase of the three groups vary, these

ISSN no: 2476-5644

results are not statistically different among each other. The use of the developed differentiated lessons using multimedia equally enhanced the conceptual understanding of the students from all the learning style groups—visual, auditory and kinesthetic group.

Table 2. *Comparison between the pre-test and posttest results on conceptual understanding per learning style*

LESSON	No. of items	Visual					Auditory					Kinesthetic					Overall				
		Pre		Post			Pre		Post			Pre		Post			Pre		Post		
		ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase
Position and Point of Reference	3	34.92	AM	82.54	MTM	**47.62**	36.36	AM	93.94	CAM	**57.58**	23.33	LM	90.00	CAM	**66.67**	31.54	LM	88.83	CAM	**57.29**
Distance and Displacement	5	29.52	LM	67.62	MTM	**38.10**	32.73	LM	58.18	AM	**25.45**	38.00	AM	68.00	MTM	**30.00**	33.42	LM	64.60	AM	**31.18**
Speed and Velocity	7	32.65	LM	68.03	MTM	**35.37**	31.17	LM	76.62	MTM	**45.45**	40.00	AM	72.86	MTM	**32.86**	34.61	AM	72.50	MTM	**37.90**
Acceleration	8	19.05	LM	69.64	MTM	**50.60**	20.45	LM	78.41	MTM	**57.95**	20.00	LM	62.50	AM	**42.50**	19.83	LM	70.18	MTM	**50.35**
Transverse and Longitudinal waves	5	21.90	LM	59.05	AM	**37.14**	21.82	LM	52.73	AM	**30.91**	22.00	LM	48.00	AM	**26.00**	21.91	LM	53.26	AM	**31.35**
Characteristics of Waves	7	14.29	VLM	68.03	MTM	**53.74**	22.08	LM	49.35	AM	**27.27**	17.14	LM	68.57	MTM	**51.43**	17.84	LM	61.98	AM	**44.15**
Mechanical vs. Electromagnetic waves	5	17.14	LM	72.38	MTM	**55.24**	14.55	VLM	67.27	MTM	**52.73**	28.00	LM	60.00	AM	**32.00**	19.90	LM	66.55	MTM	**46.66**
Total	40	24.21	LM	69.61	MTM	**45.40**	25.59	LM	68.07	MTM	**42.48**	26.93	LM	67.13	MTM	**40.21**	25.58	LM	68.27	MTM	**42.70**
ANOVA p-values:																					
Pretest	-	0.64	(not significant)																		
Posttest	-	0.89	(not significant)																		

(b.) Higher order thinking skills. Higher order thinking skills (HOTS) is based on various taxonomies of learning, particularly the one created by Benjamin Bloom (1956). These skills are reflected by the top three levels in Bloom's taxonomy: analyzing, evaluating and creating (Watson, 2018).

To determine the effect of the developed lessons on student's higher order thinking skills specifically analyzing and evaluating, a 20-item researcher-made multiple-choice HOTS test was used. This test was administered before and after the conduct of the study. Mastery level (ML) was likewise computed to determine the effects of the differentiated lessons using multimedia in developing student's higher order thinking skills.

Table 3 shows the comparison between the pretest and posttest results on higher order thinking skills per learning style group. The results show that there is improvement in the student's higher order thinking skills from Low mastery (ML=27.05%) in the pretest to average (ML=55.88%) in the posttest which resulted to a percentage increase of 28.83 percent. Paired t-test was also used to determine if the difference between the pretest and posttest results was significant. A computed p value of 0.000 is obtained which also lower than 0.05 indicating that the increase is significant.

Similar with the results in conceptual understanding, ANOVA was also used to determine if there is a significant difference among the pretest and posttest results of the three learning style groups. It was shown in the table that a p-value of 0.194 was obtained in the pretest which means that there is no significant difference between the pretest results of the three learning style groups. For the posttest results of the three groups, a p-value of 0.047 was obtained which means that there is a significant difference among the posttest results of the three learning style groups. To further determine this difference, a two-sample t-test assuming equal variances was used.

Based from the t-test results, there is a highly significant difference between the posttest results of visual and auditory group with a p-value of 0.0063. There is also a significant difference between the posttest results of auditory and kinesthetic group with a p-value of 0.0337. A p-value of 0.4330 was obtained for the posttest results of visual and kinesthetic group which means that there is no significant difference between their results.

The ANOVA results imply that the differentiated lessons using multimedia have different effects on the development of higher order thinking skills of the three learning style groups. The lessons had greatest effect on the auditory group's higher order thinking skills with an ML percentage increase of

ISSN no: 2476-5644

36.36% from low mastery (ML=28.46%) in the pretest to average (ML=64.83%) in the posttest. Meanwhile, the lessons had the same effect on the higher order thinking skills of the visual and kinesthetic group. The visual group obtained an ML percentage increase of 26.08% which improved from low mastery (ML=23.87%) to average (ML=49.94%). The kinesthetic group obtained a percentage increase of 24.05% which also improved from low mastery (ML=28.81%) in the pretest to average (ML=52.86%) in the posttest.

Table 3. *Comparison between the pre-test and posttest results on HOTS per learning style*

LESSON	No. of items	Visual					Auditory					Kinesthetic					Overall				
		Pre		Post			Pre		Post			Pre		Post			Pre		Post		
		ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase	ML (%)	Interpretation	ML (%)	Interpretation	% increase
Position and Point of Reference	1	23.81	LM	47.62	AM	**23.81**	27.27	LM	81.82	MTM	**54.55**	20.00	LM	60.00	AM	**40.00**	23.69	LM	63.15	AM	**39.45**
Distance and Displacement	2	21.43	LM	42.86	AM	**21.43**	22.73	LM	54.55	AM	**31.82**	20.00	LM	45.00	AM	**25.00**	21.39	LM	47.47	AM	**26.08**
Speed and Velocity	4	23.81	LM	52.38	AM	**28.57**	20.45	LM	63.64	AM	**43.18**	32.50	LM	55.00	AM	**22.50**	25.59	LM	57.01	AM	**31.42**
Acceleration	4	16.67	LM	46.43	AM	**29.76**	27.27	LM	65.91	MTM	**38.64**	47.50	AM	52.50	AM	**5.00**	30.48	LM	54.95	AM	**24.47**
Transverse and Longitudinal waves	2	16.67	LM	50.00	AM	**33.33**	9.09	VLM	50.00	AM	**40.91**	30.00	LM	60.00	AM	**30.00**	18.59	LM	53.33	AM	**34.75**
Characteristics of Waves	4	25.00	LM	50.00	AM	**25.00**	22.73	LM	59.09	AM	**36.36**	25.00	LM	37.50	AM	**12.50**	24.24	LM	48.86	AM	**24.62**
Mechanical vs. Electromagnetic waves	3	39.68	AM	60.32	AM	**20.63**	69.70	MTM	78.79	MTM	**9.09**	26.67	LM	60.00	AM	**33.33**	45.35	AM	66.37	MTM	**21.02**
Total	20	23.87	LM	49.94	AM	**26.08**	28.46	LM	64.83	AM	**36.36**	28.81	LM	52.86	AM	**24.05**	27.05	LM	55.88	AM	**28.83**

ANOVA p-values:
Pretest - 0.194 (not significant)
Posttest - 0.047 (significant)

(c.) Student's attitude towards Physics. One of the utmost significant factors which affect student's academic success is their attitudes towards school, lessons and academic success (Guido, 2013). This study used a standardized attitude questionnaire called Colorado Learning Attitudes about Science Survey (CLASS). The purpose of this tool is to measure student's self-reported beliefs about Physics and their Physics courses and how closely these beliefs about Physics align with experts' beliefs.

As shown in Table 4, there is a positive over-all shift of student's attitude towards Physics which is 10.69. This is computed by subtracting the pretest favorable responses from the posttest favorable responses. This effect on student's attitude may be attributed to the use of ICT and differentiation as features of the lessons developed. The use of technology in classroom setting had a great impact on student's interest and motivation which contributes to the student's attitude towards the subject. As pointed out by Wainwright, today's generation is very tech savvy so the obvious way to get to the student's hearts is to use technology in the classroom (Wainwright, 2012). Similarly, the use of differentiation based on learning styles also had a great promise in developing positive attitude towards a subject. By giving them the opportunity to learn using their learning styles, the students feel a sense of importance because the teacher was addressing their individual needs and preferences. This creates positive interest towards learning, which is also one of the contributory factors in developing positive attitude.

Table 4. *Comparison of Favorable responses of students per learning style*

Learning Style	Pretest	Posttest	Shift
Visual	42.53	54.34	11.81
Auditory	41.94	53.89	11.94
Kinesthetic	44.75	53.09	8.33
Overall	43.08	53.77	10.69

ANOVA p-values:
Pretest - 0.8038 (not significant)
Posttest - 0.9710 (not significant)

The student's attitude towards Physics was analyzed per learning style as shown in Table 4. It was shown in the table that the auditory group obtained a positive shift of 11.94, the visual group obtained a

ISSN no: 2476-5644

positive shift of 11.81, and the kinesthetic group had a positive shift of 8.33. Although the shift values vary per learning style, there is no significant difference among the pretest results of the visual, auditory and learning style group as well as their posttest results. As shown in Table 4, a p-value of 0.8038 was obtained in the analysis of variance between the responses of the three learning style groups in the pretest. Likewise, a p-value of 0.9710 was obtained in the posttest results of the three groups. Both values indicate that there is no significant difference between the results in pretest as well as the posttest of the three groups. This implies that the positive effect in the attitude of one learning style group is not significantly different as compared to the other learning style groups.

This effect may be pointed out on the use of ICT (multimedia) and differentiation based on student's learning styles. The shift on visual, auditory, and kinesthetic group may be credited on the use of multimedia. The use of multimedia elements like texts, audio, video, images, animations, and interactive slides addressed the learning preferences of the three groups.

CONCLUSIONS AND RECOMMENDATIONS

The seven lessons in Grade 7 Physics with the following features: inquiry-based, contextualized, use of ICT and use of differentiation based on students' learning styles (Visual, Auditory and Kinesthetic) dealt with the following topics: Position and Point of Reference; Distance and Displacement; Speed and Velocity; Acceleration; Transverse and Longitudinal Wave; Characteristics of Waves; and Mechanical and Electromagnetic Wave.

The juror's assessment of the differentiated lessons using multimedia obtained a rating of excellent on all the criteria—accuracy of content, presence of features of inquiry-based learning, contextualization, technical aspects, and appropriateness of activities to student's learning styles; which means the lessons excelled at meeting majority of the expectations.

The differentiated lessons using multimedia resulted to improved conceptual understanding, higher order thinking skills, and improvement of attitude towards Physics.

In the light of these conclusions, the following recommendations were made:

1. The developed lessons in this study can be adopted and utilized by Grade 7 Science teachers.
1. Other differentiated lessons using multimedia may be developed for other topics in Physics.
2. Other methods of differentiation may be employed such as differentiating based on students' readiness and interest.
3. The differentiated lessons using multimedia may be further enhanced and assessed based on other features.
4. Teachers should continue to develop multimedia-based lessons and employ differentiation in teaching.
5. Further studies should be conducted with controlled and experimental groups to determine the effectiveness of differentiated lessons using multimedia as compared to the traditional way of teaching.

REFERENCES

Alondra, G. (2015). Differentiated instruction by students' learning styles: effect on the performance in Mathematics IV. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

Antopina, R. (2016). Lessons in mechanics using experiential learning. (Unpublished Master's thesis). Bicol University, Graduate School, Legazpi City.

Aranda, M. R., & Zamora, J. (n.d.). Using differentiated instruction in improving the academic performance of students in Filipino language. National University, Manila, Philippines.

Asagra, C. (2009). Problem-based learning: an approach in teaching high school physics. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

Barmby, P., & Defty, N. (2006). Secondary school pupils' perceptions of Physics. Research in science technological education.

Besmonte, A. B. (2015). The effectiveness of contextual approach in teaching force and motion. (Unpublished Master's thesis). Bicol University Graduate School, Legazpi City.

Bilbao, P. P., Dayagbil, F. T., & Corpuz, B. B. (2015). Curriculum Development for teachers. Quezon City: Lorimar Publishing, Inc.

Bornilla, K. (2016). The use of contextualized activities in learning biodiversity. (Unpublished Master's thesis). Bicol University Graduate School, Legazpi City.

Buban, A. (2014). Differentiated learning experiences in English for diverse learners in a multi-grade

class. Unpublished Dissertation. Bicol University Graduate School, Legazpi City, Philippines.

Carascal, C. (2018). Powerpoint-based offline webquest in Grade 7 Biology. Unpublished Master's thesis. Bicol University Graduate School, Legazpi City, Philippines.

Chinedu, C. &. (2014). Implementing higher order thinking skills in the teaching and learning of design and technology education. First Technical and Vocational Education International Seminar.

Chislett, V., & Chapman, A. (2005). VAK Test. Retrieved from www.businessballs.com

Dagta, V. (2014). Use of workbook in enhancing mastery of concepts and attitude towards physics. Bicol University Graduate School, Legazpi City, Philippines: Unpublished Master's thesis.

David, L. (2015). Cognitive theory of multimedia learning (Mayer). Retrieved from Learning Theories: https://www.learning-theories.com/cognitive-theory-of-multimedia-learning-mayer.

De Garcia, P. (2013). Technology-mediated lessons in teaching motion. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

De Sousa, L., Nel, C., & Richter, B. (2017). The effect of multimedia use on the teaching and learning of social sciences at tertiary level: a case study. Retrieved from Yesterday and Today: http://www.scielo.org.za

De Vera, J. (2016). Use of strategic intervention material-based instruction (SIM-BI) in teaching chemistry. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

Dela Cruz, M. a. (2017). Science Education and a Thinking Society. Retrieved from Inquirer.net: http://www.inquirer.net

DepEd. (2016). K-12 Science Curriculum Guide. Pasig City, Philippines.

Diestro, D. (2016). Contextualization and Localization aid in reaching out. Retrieved from Pressreader: https://www.pressreader.com

Dohle, M. (2015). Quality Content for Learning Resources. Retrieved from The Association of American Pubishers: https://publishers.org/our-markets/prek-12-learning/quality-content-learning-resources

Early Learning. (2015). Engaging young learners through inquiry-based learning. Retrieved from Oxford learning: https://www.oxfordlearning.com/engaging-young-learners-through-inquiry-based-learning/

Erdemir, N. (2009). Determining students' attitude towards physics through problem-solving strategy. Asia-Pacific Forum on Science Learning and Teaching, Vol. 10 No. 2.

Fernandez, A. (2013). Standards-Based Assessment: DepEd's Perpective. National Education Testing and Research Center, Department of Education.

Goforth, C. (2015). Using and Interpreting Cronbach's Alpha. Retrieved from University of Virginia Library: https://data.library.virginia.edu

Guido, R. (2013). Attitude and Motivation towards Learning Physics. International Journal of Engineering Research & Technology (IJERT), 2087.

Gumus, S., & Okur, M. (2010). Using multimedia objects in online learning environment. Retrieved from Procedia Social and Behavioral Sciences 2: http://www.sciencedirect.com

Hale, K. (2000). Using powerpoint in the classroom. Retrieved from Investintech.com Inc: http://www.investintech.com

Hall, M. (2016). PowerPoint in the Classroom. Retrieved from The Innovative Instructor: https://ii.library.jhu.edu

Hate, M. (2012). Differentiated learning activities in English for third year students of Sta. magdalena National High School. Unpublished Master's thesis. Bicol University Graduate School, Legazpi City, Philippines.

Hudson, H. (2014). Personalised learning lets children study at their own pace. Retrieved from Technology News: http://www.newscientist.com

Jones, A. (2015). The use and abuse of PowerPoint in Teaching and Learning in the Life Sciences: A Personal Overview. Retrieved from Taylor & Francis online: https://doi.org

K-12 Curriculum Guide Science. (2013). Pasig City , Philippines.

Kennepohl, D., & Roesky, H. (2008). Drawing attention with chemical cartoons. Journal of Chemical Education.

Lari, F. S. (2014). The Impact of Using PowerPoint Presentations on Students' Learning and

Motivation in Secondary Schools . Retrieved from ScienceDirect: http://www.sciencedirect.com

Madrilejos, G. B. (2017). Guided inquiry lessons in Grade 7 Physics. (Unpublished Master's thesis). Bicol University Graduate School, Legazpi City.

Marshall, D. (2001). What is Multimedia? . Retrieved from https://users.cs.cf.ac.uk/Dave.Marshall/Multimedia/node10.html

Mataverde, D. A. (2017). Inquiry-based approach through modelling instruction in teaching Grade 7 Physics. (Unpublished Master's thesis). Bicol University Graduate School, Legazpi City.

Maxwell, D., Lambeth , D., & Cox, J. (2015). Effects of using inquiry-based learning on science achievement for fifth-grade students. Asia-Pacific Forum on Science Learning and Teaching. Retrieved from https://www.eduhk.hk/apfslt/v16_issue1/cox/page3.htm

Mayer, R. (2003). The promise of multimedia learning: Using the same instructional methods across different media. Learning and Instruction, 125-139.

Merca, M. (2012). Self-instructional modules on motion: Development, validation, and evaluation of effectiveness. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

Modini, R. (2005). Why study Physics and is Physics relevant? Retrieved from Its Education Asia: www.itseducation.asia

Muñoz, R. (2011). Strategic intervention materials in integrated science: their effectiveness in enhancing mastery performance level of students. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Philippines.

Navarro, R. L., & Santos, R. D. (2013). Authentic Assessment of Student learning outcomes. Quezon City: Lorimar Publishing, Inc.

Ocfemia, A. (2016). Development and use of powerquest in teaching genetics. Unpublished Master's thesis. Bicol University Graduate School, Legazpi City, Philippines.

Omari, T., & Chen, V. (2016). What is conceptual understanding. Retrieved from Getting Smart: http://www.gettingsamrt.com

Peña, J. B. (2012). Using multimedia technology in enhancing english competencies. (Unpublished master's thesis). Bicol University Graduate Schhol, Legazpi City, Philippines.

Pura, K. R. (2012). Development of lessons integrating computer simulations and virtual labs: effectiveness in enhancing Physics learning. (Unpublished Master's Thesis). Bicol University Graduate School, Legazpi City.

Rancea, B. (2019). 9 apps for creating multimedia content. Retrieved from ecommerce platforms: https://ecommerce-platforms.com/articles/9-apps-for-creating-multimedia-content

Randolph, J. (2008). Online Kappa Calculator [Computer software]. Retrieved from http://justus.randolph.name/kappa

Rasheed, F., & Wahid, A. (2018). The theory of differentiated instruction and its applicability: an e-learning perspective. Retrieved from Research Gate: https://www.researchgate.net

Rossman, G., & Wilson, R. (1984). Numbers and words: combining quantitative and qualitative methods in a single large scale evaluation study. Evaluation Review, Vol. 9, No. 5.

Sage Publications, Inc. (2017). Analyzing Data with Pretest and Posttest Measurements of one group. Retrieved from https://us.sagepub.com

Santamaria, L. J. (2009). Culturally Responsive Differentiated Intruction: Narrowing Gaps Between Best Pedagogical Practices Benefiting All Learners. Retrieved from https://www.essr.net

Schuell, T. (1986). Cognitive Conceptions of Learning. Review of Educational Research , 411-436.

Scott, B. E. (2012). The effectiveness of differentiated instruction in the elementary Mathematics classroom. (Unpublished Dissertation). Ball State University, Muncie, Indiana.

Sionicio, J. (2011). Multimedia use in teaching mathematics 1: Effect on the academic performance and interest of first year students of Libon agro-industrial high school. (Unpublished master's thesis). Bicol University Graduate School, Legazpi City, Phil.

Subban, P. (2006). Differentiated instruction: a research basis. International education journal 7, 935-947.

Tech Terms. (2008). PowerPoint Definition. Retrieved from The Tech Terms Computer Dictionary: https://techterms.com/definition/powerpoint

ISSN no: 2476-5644

Thomas, Y., Cole, J., & Denton, D. (2002). Improving Technological Literacy. Issues in Science and Technology.

TNHS-EMIS. (2018). Enrollment Data SY 2018-2019. Tabaco City, Albay, Philippines.

Tomlinson, C. (2000). What is differentiated instruction. Retrieved from Reading Rockets: http://www.readingrockets.org

Tomlinson, C., & Allan, S. D. (2000). Leadership for Dierentiating Schools & Classrooms. Retrieved from Association for Supervision and Curriculum Development (ASCD): http://www.ascd.org

Tural, G. (2015). Cross-grade comparison of student's conceptual understanding with lenses in geometric optics. Retrieved from www.icaseonline.net

Wainwright, A. (2012). How to engage students using technology in the classroom. Retrieved from Securedge networks: http://www.securedgenetworks.com

Watson, S. (2018). Higher-order thinking skills (HOTS) in education. Retrieved from ThoughtCo: www.thoughtco.com

Weimer, M. (2013). Inquiry-Based Approaches: What Do Students Think? Retrieved from Faculty Focus Higher Ed Teaching Strategies from Magna Strategies: https://www.facultyfocus.com

Wyatt, T. R. (2014). Understanding the process of contextualization. Retrieved from Research Gate: https://www.researchgate.net