European Journal of Innovation in Nonformal Education (EJINE)
Volume 3 | Issue 11 | Nov - 2023 ISSN: 2795-8612

The Effectiveness of Project-Based Multimedia Learning on the Stem Senior High School Students

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A B S T R A C T
This study highlights the effectiveness of Project-based multimedia learning on senior high school stem students, which plays a vital role in instruction within the real world of school practices or engagement and learning activities. It aimed to identify how effective these project-based multimedia is towards the instructional learning of STEM learners. The research methodology used was quantitative and simple random sampling, with the involvement of 26 students who were selected from Grade 11 STEM A and Grade 11 STEM B. The control group was given materials like visual aids, blackboards, and chalk, while the experimental group was given a projector, laptop, and projector screen. A pre-assessment test was conducted to identify weaknesses and strengths. The control group had a plain lecture, while the experimental group was asked to create a vlog based on the topic. A quiz was conducted to determine the effectiveness of PBML, and a survey was conducted to gather respondents' opinions on traditional teaching methods. The study found that PBML significantly improved students' learning experiences, with the control group focusing on traditional methods and the experimental group using PBML. The results showed higher scores after using modern educational technology. The study's findings support the hypothesis that implementing Project-Based Multimedia Learning improves students' learning experiences.

A R T I C L E I N F O
Article history:
Received 03 Sep 2023
Received in revised form
02 Oct 2023
Accepted 18 Nov 2023

Keywords: Effectiveness of Project-Based, Multimedia, Education, Stem Students, Senior High School.

INTRODUCTION

Millennials are highly engaged with the advancement of technology. Thus, in the education field came up a teaching method called project-based multimedia learning to capitalize on what is new for today's generation. The merging of project-based learning and multimedia represents an extraordinary project-

based multimedia learning strategy. Individually, project-based learning is a kind of instruction that helps students learn new information and skills related to creating a specific product or performance. At the same time, multimedia means integrating media objects such as text, graphics, video, animation, and sound to represent and convey information. Students' multimedia products will be technology-based presentations, such as a computerized slide show, a Web site, or a video. These presentations will include evidence that students mastered the key concepts and processes for project-based multimedia learning, strives to be accurate, and seeks the connection between the student's works in a school with the broader world in which they live.

Some educational researchers viewed project-based learning and multimedia collaboration as fully effective learning reinforcement (Baser et al., 2017; Aloraini, 2005; Tamim & Grant, 2013). These considerations are based on the study indicating that project-based multimedia learning helps students to become more critical and creative thinkers. Simpkins (2002) emphasized the significance of the method's seven key dimensions for students to attain the desired multimedia product. The core curriculum includes setting clear learning goals drawn from whatever standards are in use. Real-world connectionism is a project that a student will work hard on now and remember for a lifetime, for it discourages abstract learning. An extended time frame means a good project is not a one-shot lesson; it extends over a significant period, maybe days, weeks, or months. Student decision-making occurs when students can decide about the form and content of their final products and the process of producing them. Collaboration is working together jointly to accomplish a common intellectual purpose in a manner superior to what might have been accomplished working alone. In assessment, data must be gathered on what students have learned. Lastly, multimedia project portrays that students design and research their projects; instead of gathering only written notes, they also gather- and create- pictures, video clips, recordings, and other media objects that will later serve as the raw material for their final product.

In 2013, the Philippine government initiated extending the country's basic education cycle from ten to twelve years- K+12 Program (Cabansag, 2014). The conventional indices of learning conditions have significantly improved due to government spending on education. However, the senior high school graduates reportedly lack enough skills for employment or to be called ideal employees. The sudden change spun around the student's competencies into higher standards addressing the need for higher skills that students still do not possess. The level of technological advancement also made a vast disparity in creating globally- competitive professionals (Lall, 2001). Relying on only content learning and abstract ideas heightened the gap in how the students will attain the needed skills for their future careers (Peteros et al., 2019).

In order to be ready for a job, one has to meet the skills required for that job. Implementing project-based multimedia learning in the education system will render chances to fulfill such skills. It is because this method is in line with hard skills (math, reading, and problem-solving skills mastered at a much higher level than previously expected of high school graduates), soft skills (the ability to work in a group and to make effective oral and written presentations); and the ability to use a personal computer to carry out routine tasks (word processing, data management, and creating multimedia presentations).

RESEARCH PROBLEM

This study aimed to identify the effectiveness of Project-Based Multimedia learning on the STEM Senior High School students of CTU-MC.

Specifically, the study seeks to answer the following questions:

1. Does project-based multimedia learning help the students?
2. Is there a significant disparity between the senior high school students using and not using project-based multimedia learning?
3. What are the impediments to implementing project-based multimedia learning?

RESEARCH OBJECTIVES

The objective of this study is to identify the effectiveness of Project –Based Multimedia Learning on STEM Senior High Students in CTU so that at the end of the research, the students will be able to:

1. Identify the effectiveness of using Project –Based Multimedia Learning as a medium of the teaching-learning process,
2. Differentiate carefully the result of using and without using Project –Based Multimedia Learning.

REVIEW OF RELATED LITERATURE

Students' minds have lots of ideas that need to be guided and midwife by a teacher. What comes to our mind that is relevant and new is called learning. There are lots of theories about learning. How can a person learn? In what way does newly acquired information or learning enter our minds? According to the first and the oldest theory called vitalism. Learning was an unfolding of what was originally enfolded. Learning is innate to humans. Humans have already acquired learning but are repressed at birth and awakened and added during adulthood (Bendanillo, 2022). The minds of each individual are not empty at all. It doesn't mean that if you are not studying, you don't learn anything. Learning can be gained inside and outside the school. The only difference is that learnings inside the school are well-organized, follow a certain curriculum, and train individuals to be competent and useful citizens. While learnings outside the school may useful, like one learns how to cook, or may not be useful, like one learns how to smoke (Brubacher, 1978).

Learnings inside the school is always best when properly monitored and implemented inside the four walls of the classroom. Using varied educational tools to attain the expected learning is a must. Using technology is very relevant in capturing students' attention and achieving the goals in the school, which is to produce a holistic learner. As centuries have passed by, technology is rapidly upgraded. Technology involves human innovation, knowledge generation, and systems development for problem-solving (Joy, 2020). It encompasses the application of scientific principles and creative thinking to create tools, machines, and systems that simplify tasks, improve efficiency, and shape societies. Technological advancements throughout history, from the wheel to artificial intelligence, have profoundly influenced how humans live, work, communicate, and interact with the world. The process of technological innovation involves identifying problems or needs, conducting research and experimentation to generate knowledge, and applying that knowledge to design effective solutions. Technology has the remarkable ability to extend human capabilities, allowing us to achieve tasks that were previously unimaginable. However, it is essential to approach technology with caution, addressing ethical concerns, privacy issues, and environmental impact. Despite potential risks, responsible and thoughtful use of technology can bring about significant benefits and advancements for humanity. Technologically speaking, books, visual aids, and other means of communication between the teachers to the students are also called educational technology. However, in this modern world, the technology is already innovated. Technology is mostly referred to as computers, televisions, radios, projectors, and other gadgets. The new inventions of technology helped a lot of humans, although it has a disadvantage. Technology is for the betterment of the society. It just depends on the individual on how he uses the modern technology. In school, technology's invention helped the students to become more critical and creative thinkers. What kind of technologies must a teacher use in the classroom, especially in these modern times?

The newly implemented K-12 curriculum has a new method of capturing the attention span and ensures that students learning will retain it for a lifetime. In this method of learning, students will create an output using the multimedia (Mankovich, 2018). Project-based multimedia learning involves students developing skills in multimedia design and production. In this method of learning, the main medium to acquire the desired learning outcomes for students is the term multimedia. Multimedia in the classroom has developed rapidly with a progression from audio cassettes to the internet sites in classroom learning. Multimedia is the pattern that led to the infinite application of technologies (Abdul-Majid, 2002). Multimedia is considered one of the best medium in education because it requires more than one sense simultaneously, as it addresses the sense of sight and hearing. Multimedia programs provide different stimuli in their presentation, which include a number of elements, come as which are text, spoken words, music and sounds, graphics, and still pictures (Aloraini, 2005). Incorporating multimedia in the classroom encompasses various approaches, such as utilizing educational videos to introduce and supplement lessons, encouraging students to create their own videos to foster creativity and collaboration, incorporating spreadsheets for data analysis and problem-solving, and having students develop websites to showcase their work. These multimedia strategies provide opportunities for active learning,

engagement, and the development of digital literacy skills, allowing students to explore concepts through visual and interactive means while also enabling them to demonstrate their knowledge and skills to a broader audience (Da Costa, 2018). The name project-based multimedia learning implies the use of multimedia, and the learning activity includes a project. Project-based multimedia learning has seven key dimensions such as core curriculum, real-world connectionism, extended time frame, students' decision-making, collaboration, and assessment (Simkins, 2002).

The seven key dimensions of project-based multimedia learning may be challenging to each student and especially to the teachers, but if one has a strong real-world connection, one can hardly go wrong. A project that has a real-world connectionism is a project that a student will work hard on now and remember for a lifetime. Real-world connectionism has a great impact on the students because they see a project other than the fact that the teacher assigned it, and they will get a grade on it. Students will be intrinsically motivated because there is no room for imagination and being left behind. Students can relate, belong and apply. There are ten kinds of real-world connectionism such as; connecting through student's interest; connecting through students' experiences; connecting through significant issues; improving the real world; relating to clients; interacting with assessors; interacting with people who know; learning adult work and life skills; creating a body of work and create images of the future (Simskins, 2002). There are lots of guides and steps on how to use the project-based multimedia learning. It depends now on the facilitator how to implement this method for the betterment of the students, especially the senior high school students.

In the article Mobilizing my Students, it is stated that the students who had given mobilized project task spent a total of two lab periods in the garden – mapping the garden plots and structures, linking the maps to the garden database, and uploading the data in real-time via the wireless to the server in the computer lab. During the project, they experimented with some other PDAs or personal digital assistants applications such as Skype, which acts much like a "walkie–talkie system" over the wireless. The students were able to chat about their mapping progress to each other. This helped them to better organize their mapping strategy and avoid redundancies in data collection. Overall, using the PDAs helped mobilize students to get them out of the field and expose them to real-world applications, and it was a positive experience for both the students and teachers. They also have great possibilities in K-12 schools that lack wireless internet connectivity. There are many reference programs that may support the PDA, such as a dictionary, thesaurus, calculator, book reader, metronome, health monitor, astronomical guide, spell checker, math flashcards, grammar, foreign language, and encyclopedia, mapping programs; programs to simulate musical instruments; sketching programs; image viewers; word processing; etc. (O'Bannon & Puckett, 2007).

In Educational Psychology: Retention and Forgetting, it is stated that the efficiency with which learning takes place is influenced by many factors and conditions. It is well recognized that the background of previous learning experiences, the learner's level of mental ability and stage of maturation attained, the types of motivation utilized, the study skills employed, the interests, attitudes, and values of the learner, as well as the proper functioning of the senses, freedom from physical defects, and lack of fatigue, all constitute important factors in determining the efficiency of learning. Kelly added that retention is meant the persistence of learning, that is, the extent to which material originally learned is preserved so that it may subsequently be recalled and recognized. Successful learning is independent of the individual's ability to retain what is essential and forget the nonessential. Retention and forgetting stand in inverse relationship to each other. Thus forgetting which a normal everyday event is denotes the gradual or rapid loss of material. It involves the failure of learning to persist (Kelly, W. A., 1965).

The Gutenberg and Understanding Mass Media throws a lot of light on the subject of mass media; it is a medium that is the message. This means that the medium by which a piece of information or knowledge is communicated to us exerts a profound influence on us. The effectiveness of a piece of information depends upon the medium through which it is imparted. Dr. McLuhan thinks that electronic media affect the sensibilities greatly because they tend to massage the sense. Thus, the medium is not only the message but also the massage because it massages the sensory organs and stimulates them to respond actively. Therefore, it is important that the mass media be utilized in the classroom teaching so that the students may obtain sensory stimulation as a part of the process of instruction (Gay, 1993).

In 2006, we predicted, “location-aware learning, augmented reality, mobile collaboration, mobile gaming and simulation, and expert location await us (Metcalf, 2006).” The early potential and promises of technologies such as these have been further enhanced with advanced content and real-time data – whether images taken from a camera, Global Positioning System (GPS) coordinates, or even biometric information. These inputs can give information about our identity or perhaps our health or state of being. All of these can influence the settings, affordances, availability, and readiness for learning. Schools should have room for developing technological development and advancement to multimedia to enrich 21st-century learners (Metcalf, 2006).

Communication and effective teaching involve person-to-person interaction and strong presentation skills to fulfill students' learning needs. Teaching aids such as images, posters, and hands-on demonstrations enhance classroom communication, while resources like whiteboards, paper, and projectors create visual aids for discussions. Obtaining feedback and engaging experienced colleagues for observations and evaluations using checklists help improve communication. Preparing aids like summaries, pictures, and diagrams supports teachers in delivering lessons effectively and reinforcing understanding. Integrating these strategies and tools creates an engaging and productive learning environment (Capuyan et al., 2021).

Bishop, L. J. (1966), the Executive Secretary of the Association for Supervision and Curriculum Development, viewed in her journal Senior High School: To What Ends? the future that awaits the implementation of senior high school included in the K-12 curriculum. The senior high school curriculum has an academic track with four strands, namely, STEM (Science, Technology, Engineering, and Math), HUMSS (Humanities and Social Sciences), ABM (Accounting, Business, and Management), and GAS (General Academic Strand). Bishop stated that a rationale is needed for high school education and for the youth in our society. The assorted statements of goals, purposes, and tasks prevalent today do not constitute such a rationale: nor do the diverse views of those currently insisting on innovation form a coherent mandate for a program or for change. We will speak the other languages aside from our native languages and be trained technically, such as computer literacy. Bishop means that senior high school is the result of our government’s goal to change our educational system for the betterment of the next generation. It is to be not left behind by other countries in producing skillful and more productive citizens.

In the book Education Technology 2 by Lucido, P. I. (2012), she mentioned six fluency skills conveying the ease and facility in acquiring and using them in developing basic digital skills. These are solution fluency, information fluency, collaboration fluency, media fluency, creativity fluency, and digital ethics. Solution fluency refers to the capacity and creativity in problem-solving. Information fluency involves three subsets of skills which are the ability to access information, retrieve information and reflect on, assess, and rewrite for instructive information packages. Collaboration fluency refers to teamwork with virtual or real partners in the online environment. Media fluency refers to channels of mass communication or digital sources. Creativity fluency elements are font, color, patterns, and layout, which are artistic proficiency adding meaning by way of design, art, and story-telling to package a message. The mentioned skills help teachers adjust their teaching to effectively match the new digital world of information and communication technology (ICT); they must be clear on what basic knowledge, skills, and values (literacies) need to be developed by digital learners.

Lucas & Corpuz (2014), in their book Facilitating Learning: A Metacognitive Process, explained the difference between the quotations “filling up the pail” from “lighting the fire.” The first one is more linked to rote learning and behaviorism. It connotes that teaching is dominated by the teacher, and the learners are passive receivers of knowledge. The second is related to the cognitive perspective and constructivism. It signifies that teaching involves giving opportunities for learners to explore and discover. Learners construct their own meaning. Learners generate insights and are “enlightened.” Lucas and Corpuz (2014) mentioned two views of constructivism which are individual and social constructivism. Individual constructivism is also called cognitive constructivism and emphasizes individual, internal construction of knowledge. Social constructivism emphasizes that “knowledge exists in a social context and is initially shared with others instead of being represented solely in the mind of an individual.” According to Eggen, Kauchak & Garry (2007), four characteristics that these two views have in common are: learners construct understanding; new learning depends on current understanding;

learning is facilitated by social interaction and; meaningful learning occurs within authentic learning tasks.

There are other approaches where the learner's environment is given a greater role. Maria Montessori developed a method of education (Montessori, 2011) that promoted the importance of the child's environment. She proposed that the stages in the child's development were closely linked to the content and environment of the curriculum. However, the important environment for Montessori was not that which occurred naturally as part of the child's social culture but one that needed to be manufactured especially for the child. The method by which the child's development was influenced by their environment was also distinct. Montessori (2011) saw children as accumulating material by means of their 'absorbent mind,' a clear contrast to the strenuous mental activity leading to the creation of mental processes envisaged by Vygotsky.

Education (and more specifically, developmental education) has evolved as the result of technology. Beginning with the hunting and gathering age, through the agrarian age, and then into the industrial age, expert elders taught and developed their apprentices using oral communication such as storytelling and recitation. With the invention of technologies like writing 5,000 years ago and the printing press 500 years ago, these elders were able to use these technologies to collect and organize data bits of their knowledge and convert it into printed information, making it available to growing numbers of apprentices who were the emerging literate (Brockman, 2001). Thus education shifted as a result of technology toward teaching the novice how to develop knowledge from information –knowledge development resulting from thinking while reading, from debating what has been read, from coming to group understanding, and from expressing individual understanding through speaking and writing (Niess, 2005).

The role of technology in the curriculum springs from the very vision of the e-Philippine plan (e stands for electronic). Thus it is stated that an electronically enabled society where all citizens live in an environment that provides quality education, efficient government services, greater sources of livelihood, and ultimately, a better way of life through enhanced access to appropriate technologies (Dahlman et al., 2016).This points to the need for an e-curriculum, or a curriculum that delivers learning consonant with the Information Technology and Communication Technology (ICT) revolution. Thus among educational goals desired for achievement in the honing of competencies and skills of a new breed of students, now better referred to as a generation competent a literacies to the 3 Rs (or reading, 'writing, and 'arithmetic) but influences, more particularly: problem-solving fluency, information access and retrieval of texts/images/sound/video fluency, social networking fluency, media fluency, and digital creativity fluency (Bilbao et al., 2015).

It's always natural for a thing to possess a limitation. No matter how good it is, there is always it's the other side. Also, the project–based multimedia has limitations and challenges. The student's and teachers' challenges in undertaking project–based multimedia learning include students' group work and students' preference for traditional teaching style. This challenge is for the students who are unfamiliar with modern technology. Those students who are living in mountainous places. The only way to overcome this challenge is to adapt and continue engaging and practicing the innovation of technologies. Next, is the student's need for extended periods of time? Teachers must orient the students or what is expected of them. And last is the needed technical skills of the teacher to implement the method appropriately (Harmer et al., 2014).

Project–based multimedia learning's limitations and challenges cannot overcome its relevance and effectiveness if properly implemented. This is a hands –on-minds –on- hearts –on method by John Dewey (Bilbao et al., 2015). There are a lot of claims and researchers that want to prove that this method is effective. Now, this study aims to identify its effectiveness.

METHODOLOGY

This study aims to identify the effectiveness of Project –Based Multimedia Learning on STEM Senior High Students in CTU-MC. The research methodology was employed to achieve the research objectives and answer the research questions of this study. The methodology used in this study was quantitative and simple random sampling. The quantitative data shows how most STEM Senior high students in CTU–MC responded to the related topic. Furthermore, it also used materials such as Visual aid, Paper, Ball pen,

Blackboard, Camera/Smart Phone, Projector, and Laptop. It was then observed through the provided general procedure: 1) a paper consent allowing to observe and conduct research on a Science class of the STEM Senior High School Students in CTU-MC was prepared and presented. 2) The researchers gathered the population through simple random sampling, where they selected 26 students, 13 from Grade 11 STEM A and 13 from Grade 11 STEM B. The 26 students were divided into two groups: the first group was the controlled group, and the second was the experimental group. 3) For the control group, the researchers set the materials such as visual aid, blackboard, and chalk inside the classroom. In contrast, the projector, laptop, and projector screen were set for the experimental group. 4) The researchers had a pre-assessment test first to identify their weaknesses and strength about the topic. 5) The researchers discussed Limiting reactants in Stoichiometry in both setups. 6) The researchers assigned to the control group just had a plain lecture until the end of the topic, while the experimental group was tasked to create a vlog that applies the topic in real-life situations. 7) The researchers conducted a quiz to both set up to determine the effectivity of PBML through the gathered scores and their output. 8) The researchers surveyed the respondents to determine whether they prefer the traditional way of teaching or PBML in enhancing their learning. The control group is the Grade-11 STEM Senior High School Students in CTU–MC without using project–based multimedia learning. The researchers merely discussed the topic of the Limiting Reactant in Stoichiometry. The students applied a traditional method of learning. After the discussion, the students were tested through a quiz if they understood the discussion. The experimental group is the Grade 11 STEM senior high school students using Project–Based Multimedia Learning. The researchers used videos, clip art, a computer, and a projector to present the topic of Limiting Reactants in Stoichiometry. After the discussion, the students were asked to create a vlog relating to the topic. They will be engaged in putting effects, animations, and other technology applications for them to have a direct experience. After the task, the teacher conducts a quiz, gathering the scores.

RESULTS AND DISCUSSIONS

The purpose of this study is to determine the effectivity of Project –Based Multimedia Learning on STEM Senior High School Students. The employment of control group and experimental group was done to achieve the study's goal. Pre-Assessment Test and Post Test scores of students' performance in projects and quizzes were gained and computed. Results of this study were presented in tables and graphs in both control group and experimental group.

Among the senior high school students in CTU –MC, there were 13 participants as the controlled group and 13 participants in the experimental group. Tables 1-2 show the results of the students who weren't applied in PBML, while Tables 3-4 are the students who were engaged in PBML

Table 1. Frequency Distribution on the Pre-Assessment Scores of the 13 Grade-11 STEM Students in Science without using Project –based Multimedia Learning

CLASS	f	CLASS BOUNDARIES	Xm	f.Xm	<Cf	>Cf	Rf
15-16	4	14.5 - 16.5	15.5	62	4	13	30.80
17-18	5	16.5 - 18.5	17.5	87.5	9	9	38.50
19-20	2	18.5 - 20.5	19.5	39	11	4	15.00
21-22	0	20.5 - 22.5	21.5	0	11	2	0.00
23-24	0	22.5 - 24.5	23.5	0	11	2	0.00
25-26	0	24.5 - 26.5	25.5	0	11	2	0.00
27-28	0	26.5 - 28.5	27.5	0	11	2	0.00
29-30	2	28.5 - 30.5	29.5	59	13	2	15.40
TOTAL	13				81		100.00

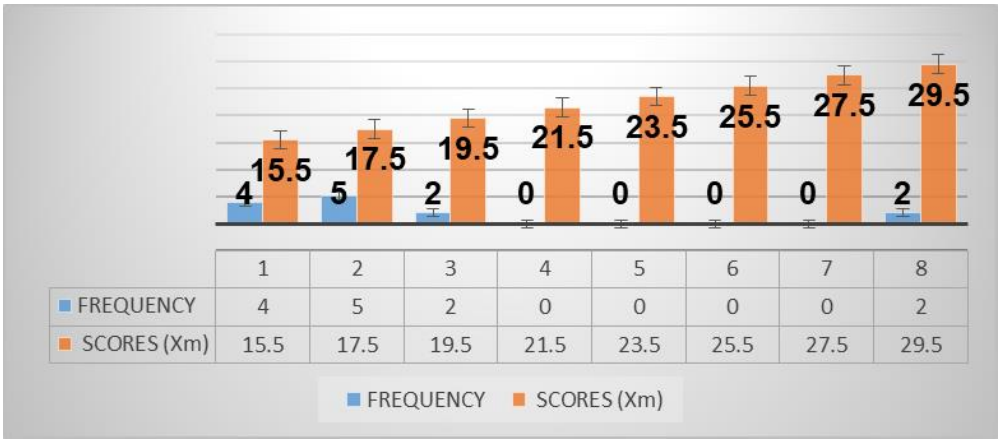
It was shown in the table, that the highest frequency was Class 17-18 with five (5) frequency and the lowest was Class 21-28 with zero (0) frequency.

Table 2. Frequency Distribution on the Post-Assessment Scores of the 13 Grade-11 STEM Students in Science without using Project –based Multimedia Learning

CLASS	F	CLASS BOUNDARIES	Xm	f.Xm	<Cf	>Cf	Rf
32-33	4	31.5 - 33.5	32.5	130	4	13	30.80
34-35	7	33.5 - 35.5	34.5	241.5	11	9	53.80
19-20	1	35.5 - 38.5	37	37	12	2	7.70
21-22	1	38.5 - 40.5	39.5	39.5	13	1	7.70
TOTAL	13				28		100.00

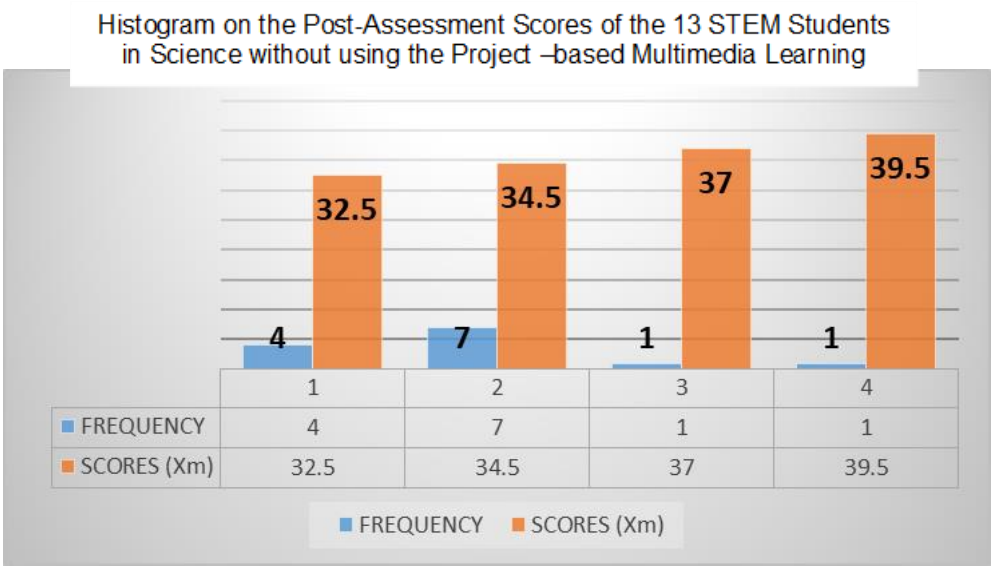
It was shown in the table, that the highest frequency was Class 34-35 with seven (7) frequency and the lowest was Class 19-22 with one (1) frequency.

Figure 1.1
Histogram on the Pre-Assessment Scores of the 13 STEM Students in Science without using the Project –based Multimedia Learning



It was shown in the graph, that the highest Class Marks was 29.5 with eight (8) frequency and the lowest Class Marks was 15.5 with four (4) frequency.

Figure 2.1



It was shown in the graph that the highest scores was 24.5 with frequency of eleven (11) and the lowest scores was 28.5 with zero (0) frequency polygon.

Table 3. Frequency Distribution on the Pre-Assessment Scores of the 13 Grade-11 STEM Students in Science using Project –Based Multimedia Learning

CLASS	F	CLASS BOUNDARIES	Xm	f.Xm	<Cf	>Cf	Rf
13-14	1	12.5 - 14.5	13.5	13.5	1	13	7.70
15-16	8	14.5 - 16.5	15.5	124	9	12	62.00
17-18	2	16.5 - 18.5	17.5	35	11	4	15.00
19-20	1	18.5 - 20.5	19.5	19.5	12	2	7.70
21-22	0	20.5 - 22.5	21.5	0	12	2	0.00
23-24	0	22.5 - 24.5	23.5	0	12	2	0.00
25-26	0	24.5 - 26.5	25.5	0	12	2	0.00
27-28	0	26.5 - 28.5	27.5	0	12	2	0.00
29-30	1	28.5 - 30.5	29.5	29.5	13	2	7.70
TOTAL	13				94		100.00

It was shown in the table above that the highest frequency was Class 15-16 with eight (8) frequency and the lowest was Class 21-28 with zero (0) frequency.

Table 4.

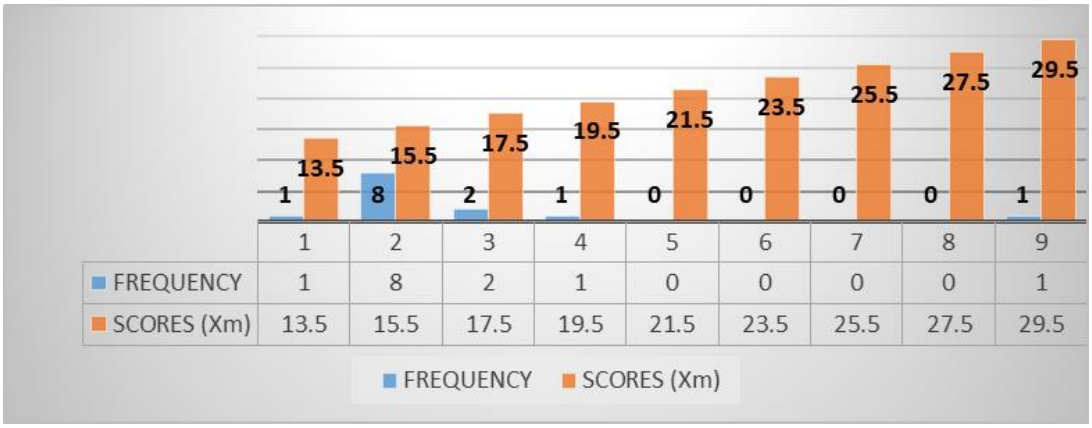
Frequency Distribution on the Post- Assessment Scores of the 13 Grade-11 STEM Students in Science using Project –Based Multimedia Learning

CLASS	F	CLASS BOUNDARIES	Xm	f.Xm	<Cf	>Cf	Rf
36-37	2	35.5 - 37.5	36.5	73	2	13	15.40
38-39	5	37.5 - 39.5	38.5	192.5	7	11	38.50
40-41	6	39.5 - 41.5	40.5	24.3	13	6	46.20
TOTAL	13				22		100.00

It was shown in the table, that the highest frequency was Class 40-41 with six (6) frequency and the lowest was Class 36-37 with two (2) frequency.

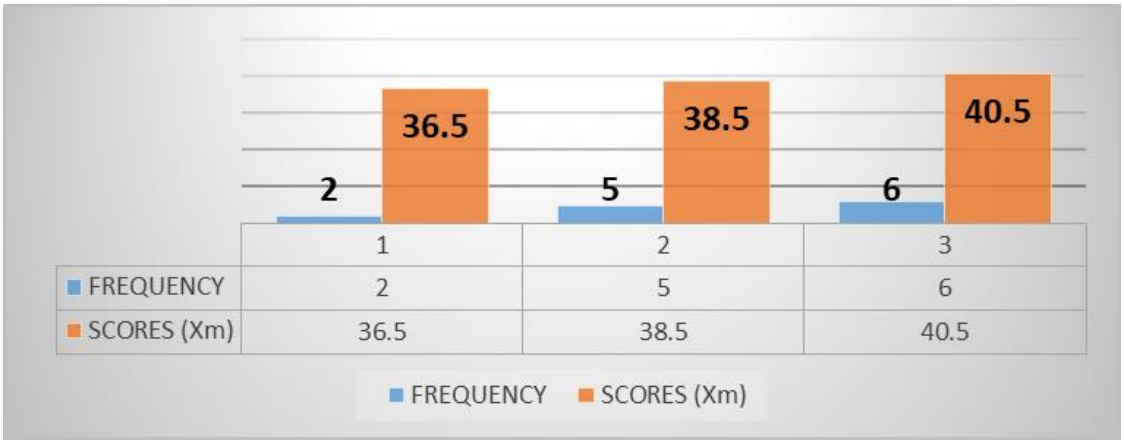
Figure 3.1

Histogram on the Scores of the 13 STEM Students in Science using the Project –based Multimedia Learning



It was shown in the graph above that the highest of scores was 29.5 with frequency of nine (9) and the lowest of scores was 13.5 with frequency of one (1).

Figure 4.1
Histogram on the Scores of the 13 STEM Students in Science using the Project –based Multimedia Learning



It was shown in the graph above that the highest scores was 40.5 with frequency of six (6) and the lowest scores was 36.5 with frequency of one (1).

DATA ANALYSIS

The study conducted at CTU-MC aimed to assess the effectiveness of Project-Based Multimedia learning among senior high school students. The results presented in the tables indicate a comparison between the control group (not exposed to project-based learning) and the experimental group (exposed to project-based learning).

In Table 1, the majority of the control group obtained pre-assessment scores ranging from 17-18, which fell below the passing score of 32. This implies that before the project-based learning intervention, the control group had a relatively lower level of knowledge. However, Table 2 reveals that the control group experienced improvement in their post-assessment scores, with a majority achieving scores of 34-35, which exceeded the expected passing score. This indicates that factors other than the project-based learning intervention might have contributed to their improvement.

On the other hand, Table 3 illustrates that the majority of the experimental group obtained pre-assessment scores ranging from 15-16, also falling below the passing score of 32. This manifests that, similar to the control group, the experimental group had a lower level of knowledge before the project-based learning intervention. However, the remarkable finding is presented in Table 4, where the majority of the experimental group achieved a perfect score of 40 in the post-assessment. This entails a substantial improvement in their scores after being exposed to the project-based learning intervention.

While the tables provide an overview of the scores and show some trends, it is important to conduct further statistical analysis to draw robust conclusions. Measures such as calculating the mean, standard deviation, and conducting hypothesis tests like t-tests can provide a clearer understanding of the effectiveness of the project-based learning intervention. These statistical analyses would help determine if the observed differences in scores between the control and experimental groups are statistically significant, thus providing stronger evidence of the impact of project-based multimedia learning in CTU-MC.

DISCUSSION

Project-Based Multimedia Learning significantly improved STEM Senior High School students' performance in CTU-MC, with significant differences between experimental and control groups. This indicates that Project-Based Multimedia Learning has a positive impact on the students' academic outcomes. By engaging students in hands-on projects using multimedia tools, the experimental group was able to achieve higher scores compared to the control group, who received traditional instruction methods. These findings provide strong evidence supporting the alternative hypothesis that Project-Based Multimedia Learning enhances student performance. These findings corroborates to the previous study conducted by Untari et al. (2020), who argued that apparently, there is an effectiveness of the application

of interactive multimedia and it has a significant positive effect on learning achievement from the learners.

The analysis of the STEM Senior High School students in CTU-MC revealed that although the experimental and control groups had similar tables and graphs, they differed in the values obtained. This implies that the implementation of Project-Based Multimedia learning effectively enhances the students' performance and scores. The use of multimedia tools likely contributed to the students' improved performance by providing them with interactive and engaging learning experiences. By incorporating technologies in their learning process, the students were able to better understand and apply STEM concepts, leading to higher scores compared to their peers in the control group. This recent study has been conformed with the previous study conducted by Kefalis & Drigas (2019), who opined that multimedia learning tools help both teachers and learners access knowledge easy and effective promoting digital literacy and finally online games encourages and motivates students helping them learn in a playful way.

One potential factor that influenced the effectiveness of Project-Based Multimedia Learning was the students' prior experience with technology. Some students in the experimental group, who were novices in handling technologies, struggled to keep up with the goals and objectives of the projects. The prominence of technology in the learning process may have overshadowed their focus, causing them to lose track. However, despite these challenges, the experimental group still outperformed the control group, suggesting that even students with limited technological skills can benefit from Project-Based Multimedia Learning.

The positive results of this study highlight the potential of Project-Based Multimedia learning as an effective instructional approach in STEM education. The hands-on nature of the projects, combined with the use of multimedia tools, allows students to actively engage with the subject matter and apply their knowledge in real-world contexts. This approach improves students' STEM comprehension, critical thinking, problem-solving, and collaboration skills for success (Capraro & Slough, 2013).

To ensure the continued success of Project-Based Multimedia learning, it is crucial to provide support and guidance to students who may struggle with the technological aspects of the approach. Additional training or resources can be provided to help students become proficient in using the necessary technologies, enabling them to fully participate in the projects and achieve optimal learning outcomes. Furthermore, ongoing assessment and evaluation should be conducted to monitor the effectiveness of Project-Based Multimedia Learning and identify areas for improvement (Bagheri et al., 2013). By addressing the challenges and maximizing the benefits of this instructional approach, educators can create a stimulating and effective learning environment for STEM Senior High School students.

CONCLUSION

The main objective of this study is to determine the effectiveness of Project–Based Multimedia Learning in STEM Senior High Schools in CTU –MC. A total of 26 STEM Senior High students participated in this study. Students were experienced to undergo the teaching and learning process with the use of Project –Based Multimedia Learning and without the use of it. The experimental and control groups' students were used to measure the effectiveness of Project –Based Multimedia Learning on STEM Senior High students. The hypothesis was tested by implementing Project–Based Multimedia learning in a STEM Senior High School Class. The effect of using traditional learning and Project –Based Multimedia Learning were identified and compared through scores. The result showed that students' scores were higher after using modern educational technology. The data's that were gathered and analyzed proved the effectiveness of Project–Based Multimedia Learning on STEM Senior High School Students in CTU –MC.

RECOMMENDATIONS

Based on the study and analysis of the results, this paper makes the following recommendations to teachers, school administrators, and government agencies in the education field:

1. Implement Project-based multimedia learning as the primary method of teaching.
2. Create achievable standards of grades for students based on their skills.

3. Build up more globally competitive teachers.
4. Arrange proper training for teachers in handling multimedia equipment and other technology that are useful for instruction
5. Research often generates issues that raise the interest of researchers. As a result of the present study, further study can build on its research to enrich existing knowledge in the area of Project–Based Multimedia learning, and ideas for further research have also emerged.
6. Design a specific subject wherein students are to be acquainted with and improve their awareness of multimedia
7. Diagnosis and remediation are basic needs of curriculum transactions. Teachers could utilize computer technology in a day to day remedial instruction. This will not only help to enhance the instructional process but will also save their time and energy.
8. Establish partnerships with countries or cities with similar technology infrastructure and resources. Immediate interaction or fast feedback is the key to the success of a technology community. The lack of appropriate support (hardware, software, and training) may hinder to utilize and put off teachers' and students' interest and momentum.
9. Access to resources might be available. Still, students cannot use Project –Based Multimedia Learning in the classroom because it may be difficult for them to operate Project–Based Multimedia learning tools. Thus students always need technical assistance because this assistance may provide them up–to–date equipment in the new world of technology.

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