

# Effects of Multimedia in Teaching Science: Implication to Practice in Secondary Basic Education

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## ABSTRACT

Given its positive influence on the teaching and learning process, the promising effect of multimedia in education has proved its significance. This study aimed at assessing the effectiveness of multimedia in teaching secondary science subject. An experiment of two equivalent groups was designed, one is experimental and the other is controlled; each of them consists of 40 respondents of mixed gender (male and female). Discussion was made to the first group using multi-media presentations/ video clips generated from the internet treated as the experimental group. While the second group was given the same lecture using the traditional method which used the dialog & discussion technique treated as a control group. Both groups were subjected to pre & post- test in the discussions or lectures on Gas Laws specifically Boyle's Law. The analysis result of the pre- test showed no significant differences, which in turn proves the equivalence of the two groups. Meanwhile, the analysis result of the post test showed that there were significant differences between the experimental group and the control group at a significance level of 0.05 for the interest of the experimental group. Since the students in Chemistry showed positive attitude towards the subject and towards the integration/ use of multimedia technology, then it is highly recommended that the administration and the faculty should work hand in hand in maintaining the learning environment conducive for learning by providing multimedia technologies such as Smart TV, allowing gadgets like cellphones, laptops, tabs, etc. inside the classrooms so that learning will be smoothly delivered with authenticity.

**KEYWORDS:** Teaching science, ICT integration, quasi experimental design, basic education

## INTRODUCTION

It is not undeniable that science education plays an important role in the development of a nation. Shah and Khan (2015) stressed that science is the key to a nation's prosperity. In the Philippines, however, the rate of science education has deteriorated in the last decades. Previous studies have shown that the current state of science education in the Philippines lags behind other countries in the world, especially in the level of basic education. The findings of the Second International Science Study (SISS) and the Third International Mathematics and Technology Study (TIMSS) placed the Philippines in disadvantaged positions among the participating nations (Philippine Department of Education, Culture, and Sports et al. 2000). In the SISS, the Philippines ranked almost at the bottom of the list of seventeen (17) nations which took part in this large-scale evaluation of educational achievement. Similar outcomes were revealed in the 1995, 1999 and 2003 TIMSS. In addition, in the 1999 and 2003 TIMSS the Philippines placed third and fourth to last in the list of nations respectively. Findings from studies focused in the Philippines (Calacal 1999, Capistrano 1999, Orleans 1994, Figuerres 1985; Aburayya et al., 2020c) also offer the same hypothesis of low student achievement.

According to results of the Programme for International Student Assessment (PISA) released on 14 December 2019

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by the Organization for Economic Cooperation and Development (OECD), Filipinos performed worst among 79 countries in reading literacy and second lowest in both mathematical and science literacy (Cruz, 2019). This poor student achievement has prompted educational researchers worldwide to continuously identify factors that can account for academic outcomes in the classroom. Some research suggests that there's a need to move beyond traditional in the classroom settings. One example is the use of multimedia in the classroom. Mayer (2001) stated that multimedia provides a complex multi-sensory experience in exploring our world through the presentation of information through text, graphics, images, audio and video, and there is evidence to suggest that a mixture of words and pictures increases the likelihood that people can integrate a large amount of information. Moreover, multimedia teaching is a means of instructional delivery usually used with the traditional method of teaching (Rolfe & Gray, 2011; Aburayya et al., 2020a). It is a presentation consisting of words, sound, and pictures that is designed for meaningful learning (Mayer, 2005). Similarly, multimedia learning is widely used in science education where the use of pictures and text can bring complex structures and processes to life (Rolfe & Gray, 2015; Aburayya et al., 2020b). Shah & Khan (2015) also claimed that the use of multimedia in education has proven its importance due to its positive impact on the teaching and

learning process (Suson & Ermac, 2020; 2011; Aburayya et al., 2019b).

Moving from the book to the computer is a chance for greater interactivity and new ways of thinking about a learning experience. Technology offers further ways of expressing ideas through various media platforms. Such technical advancements call for pedagogical enquiries to ascertain the efficacy of the modern learning facilitation activities. Learners who have access to multiple representations enhance their comprehension, learning, memory, communication and inference (Rogers & Scaife, 1996). Kozma (1991) argues that if the instructional methods include, execute or model cognitive operations that are important to the task and the situation, learners will gain more. Learners can also benefit more if the operations provided by these representational media can be done or provided for by themselves (Kozma, 1991; Aburayya et al., 2020b; Suson & Ermac, 2020). Moreover, Plass, Moreno, and Mayer (2010) found out that multimedia could increase critical cognitive processing required to achieve the desired instructional results (Mayer, 2009; Aburayya et al., 2019a; Plass, et al., 2010).

## LITERATURE REVIEW

Understanding the ways technology has helped with education and the actual impact this made will help you to see how vital technology has become in the education world. Using this approach can deepen student learning by supporting instructional objectives. However, it can be challenging to select the “best tech tools while not losing sight of your goals for student learning. Once identified, integrating those tools can itself be a challenging eye-opening experience. As technology grows, student’s learning will become more complex. They may become more curious and selective of their learning. Technological advances have changed the world of education in the 21st century. Knowing about these advancements and the impact they have on education around the world can show just how essential technology is to education.

Several scholars contribute to the importance of multimedia in teaching and learning. Multimedia learning is a well-established form of teaching in the life sciences and is

frequently used to supplement or combine with conventional teaching elements (Pereira et al., 2007; Suson et al., 2020) or to replace other ‘traditional’ teaching methods (Dewhurst et al., 1994; Gibbons, 2004) altogether. In the 1950s, the use of mechanical devices as educational tools originated with Skinner’s “teaching machine,” a machine that allowed students to answer questions (Skinner, 1960), and later developed the notion of computers as educational tools (Suppes, 1972). The affordability and availability of desk-top computers fuelled the growth of electronic educational services, so-called computer-aided learning or instruction (CAL / CAI), in progress. Early software required some degree of programming expertise (Dewhurst et al., 1994), whereas later tools could be generated more easily with commercial authoring solutions (Gibbons, 2004).

## OBJECTIVE OF THE STUDY

The present study investigates the promising effects of multimedia technology in teaching Science as to the pre-test and post-test performance of students with and without using the multimedia and also the perceptions of the teachers and students on the use of multimedia in teaching – learning science.

## METHODOLOGY

This study utilizes quantitative and qualitative methods, because it involves data-gathering through the use of research tools such as checklists and questionnaires. The quantitative research focuses on validity, reliability, and will explain and projects generalization from other people which measure the variable(s) of interest. Qualitative research is a design which gives a better understanding from peoples’ experiences or point of view. Experimental design will be used which relies on statistical analysis to prove or disprove the hypothesis. Relevant data are gathered by means of giving teacher-made test and checklists to the students prepared by the researcher from an inventory of Science Teaching Competencies in Grade 10 Chemistry specifically on Boyle’s Law (Gas Law) Topic. The respondents of the study will be the selected Grade 10 Junior High School students officially enrolled for the school year 2018-2019 at Nangka National High School.

## RESULTS AND DISCUSSIONS

The distribution of Pre-Test Performance of the students in Science 10 which used the different scientific skills such as understanding, investigating and calculating pressure and volume at constant temperature. There was specific number of examples in each competency in both groups: controlled group and experimental group.

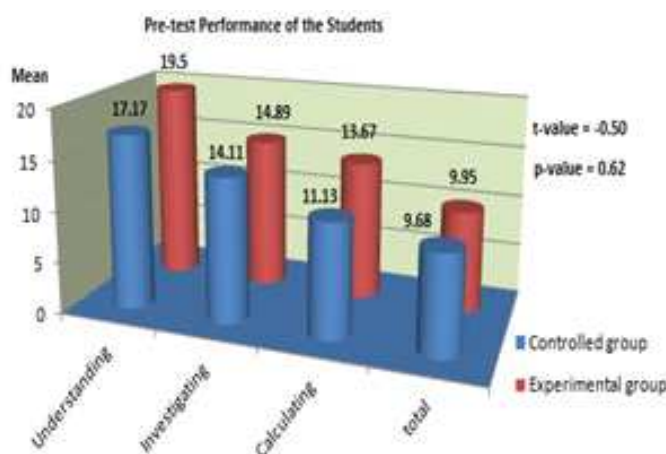
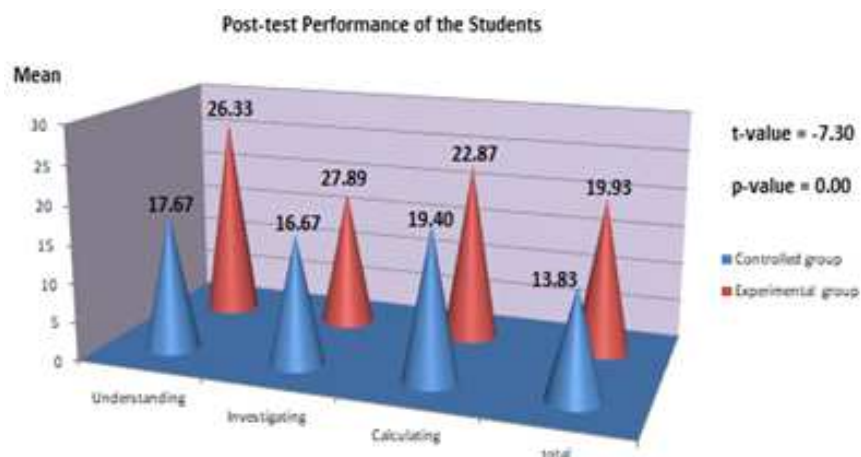


Figure 1 Pre-test performance of the students

Figure 1 shows the results of pre-test performance of the students prior to the intervention. Data shows that experimental group has the following weighted means; 19.50 in understanding how gases behave based on the motion and relative distances between gas particles; 14.89 in investigating the relationship between volume and pressure at constant temperature of a gas; and 13.67 in calculating changes in volume and pressure at constant pressure with a total 9.95. The results showed that the two groups had different weighted means on every skill before the experiment is conducted.



**Figure 2 Post-test performances of the students**

It is shown in figure 2 the different weighted mean scores after the intervention. In the competency, understanding how gases behaved based on the motion and relative distances between gas particles, the experimental group was exposed to a video clip entitled: Boyle's Law: Intro, Application, Problems, and demo, Boyle's Law Explained by Chem Academy. The students went to the science laboratory and performed the actual activity based on the video they had watched. In the activity, "Getting to Know Gases", it helped the students gain understanding of the concept and properties of gases. In this competency, students applied what they had learned in the video by performing an experiment using a syringe and a balloon. As they pushed the plunger of the syringe they noticed that the balloon decreased in size, but as they pulled the plunger up, the size of the balloon increased. And lastly in the third competency, calculating changes in volume and pressure based on Boyle's law, the above mentioned group was exposed to view clips entitled: Boyle's Law Practice Problems, Boyle's Law Ben's Chemistry Videos. In this competency, the students were given sets of problem solving questions to answer. It was easy for them to answer problem solving related activities with the aid of multimedia. The findings also revealed that the two (2) groups had different weighted means on every skill, however the results varied in every competency. Since the total p value is 0.00 which is less than 0.05 (two tailed and one tailed) means that there is a significant improvement on the science performance after the experiment on the integration of multimedia in teaching was conducted.

**Table 1 Perceptions of the students group on the use of multimedia in teaching-learning**

QUESTIONS	SA	A	D	SD	Weighted Mean	Interpretation
No matter what happens this subject always comes first.	13	18	38	11	2.41	Disagree
This subject will benefit all students.	11	24	25	20	2.33	Disagree
I love to study topics belong to chemistry subject.	12	42	14	12	2.68	Agree
This subject has something to do with my future career.	8	41	19	12	2.56	Agree
This subject has an irresistible attraction for me.	16	37	15	12	2.71	Agree
I am enjoying this subject.	25	30	17	8	2.90	Agree
This subject will develop good reasoning ability.	10	33	27	10	2.54	Agree
This subject teaches me to be accurate.	28	20	21	11	2.81	Agree
I could do very well without this subject.	7	19	36	18	2.19	Disagree
I am willing to spend my time studying this subject.	14	29	21	16	2.51	Agree
I will do assignments if these use internet or multimedia.	19	38	16	7	2.86	Agree
I find it interesting making power point presentations using multimedia.	12	30	24	14	2.50	Disagree
I love to browse googles in searching for the answers to my assignments.	35	32	10	3	3.24	Agree
I am very interested in social media especially facebook, Instagram and the like.	54	16	6	4	3.50	Strongly Agree
I want to spend my leisure time watching downloaded movies/ video-clips rather than playing outside or go out with friends.	11	22	32	15	2.36	Disagree
I prefer to make projects using multimedia.	17	21	25	17	2.48	Disagree
I love to answer problem solving questions related to science especially when these are presented/ explained using multimedia.	39	29	7	5	3.28	Strongly Agree
I find it enjoyable playing computer games or online games at home or during free time.	25	40	7	8	3.03	Agree

I find it easy to answer problem solving related questions when these are projected on the TV through screen mirroring.	12	30	20	18	2.45	Disagree
For me, the topic is best understood when it is presented using multimedia.	35	27	10	8	3.11	Agree

Table 1 shows that students with regard to their perception on the subject chemistry, Disagree on putting chemistry as the priority subject with a mean of 2.41, chemistry would benefit every student with a mean of 2.33, they could do very well without this subject with a mean of 2.48, found it interesting making power point presentations using multimedia with a mean of 2.50, wanted to spend their leisure time watching downloaded movies/ video-clips rather than playing outside or go out with friends with a mean of 2.36, preferred to make projects using multimedia with a mean of 2.48 and found it easy to answer problem solving related questions when these are projected on the TV through screen mirroring with a mean of 2.45. However, they Agree in the statements that they loved to study topic belongs to this subject with a mean of 2.68, this subject had something to do with their future career with a mean of 2.56, this subject had an irresistible attraction for them with a mean of 2.71, they enjoyed this subject with a mean of 2.90, this developed good reasoning ability with a mean of 2.54, this subject taught them to be accurate with a mean of 2.81, willing to spend their time studying this subject with a mean of 2.51, they would do assignments if these use internet or multimedia with a mean of 2.86, they loved to browse googles in searching for the answers to their assignments with another weighted mean of 3.24, they found it enjoyable playing computer games or online games at home or during free time with a mean of 3.03, and for them, the topic is best understood when it is presented using multimedia with a mean of 3.11. They Strongly Agree in the statements that they were very interested in social media especially facebook, instagram and the like with a mean of 3.50, and they loved to answer problem solving questions related to science especially when these are presented/ explained using multimedia with a mean of 3.28.

**Table 2 Perceptions of teachers on the use of multimedia in teaching-learning**

QUESTIONS	SA	A	U	D	SD	Weighted Mean	Interpretation
I am motivated to find ways to use SMART TV or computer in my classroom.	6	4	0	0	0	4.60	Strongly Agree
I usually browse the net searching for the answers/ explanations to a difficult topic/ subject matter.	5	5	0	0	0	4.50	Strongly Agree
My students have access to all forms of technology at any time during the instructional day.	0	5	1	4	0	3.10	Undecided
One of my technology goal is for students to be able to use the classrooms' smart TV or cellphone as another tool for learning.	5	5	0	0	0	4.50	Strongly Agree
I find Multimedia Technology (Smart TV/ cellphone) to be an important part of the classroom.	6	4	0	0	0	4.60	Strongly Agree
I rely on others (assistant, co- worker, or volunteer) to do computer related tasks for me in my classroom.	0	3	0	2	5	2.10	Disagree
Integration of technology in the classroom can reduce drop-out rates or absenteeism.	4	6	0	0	0	4.40	Strongly Agree
Teachers with more education are likely to use ICT resources in teaching-learning more effectively.	4	3	3	0	0	4.10	Agree
Teachers who have access to ICT resources are likely to integrate technology in teaching-learning process.	7	3	0	0	0	4.70	Strongly Agree
Students are more focused in learning the subject if this is projected on the screen via sky share or screen mirroring.	6	4	0	0	0	4.60	Strongly Agree
TOTAL	43	42	4	6	5	4.12	Agree

Science teachers were also asked to give their reaction on the five point scale survey. After the statistical treatment of the data the findings revealed that teachers strongly agree in the statements which follows: they are motivated to find ways to use Smart TV or computer to their classroom with a mean of 4.60, they usually browse the net searching for the answers/ explanations to a difficult topic/ subject matter with a weighted mean of 4.50, one of their technology goals is for students to be able to use the classrooms' smart TV or cellphone as another tool for learning with another weighted mean of 4.50, they found Multimedia Technology (Smart TV/ cellphone) to be an important part of the classroom with a weighted mean of 4.60, they believed that integration of technology in the classroom can reduce drop-out rates or absenteeism 4.40 as its weighted mean, teachers who have access to ICT resources are likely to integrate technology in teaching-learning process with a mean of 4.70, and students are more focused in learning the subject if this is projected

on the screen via sky share or screen mirroring with a mean of 4.60. They agree that teachers with more education are likely to use ICT resources in teaching-learning more effectively with a mean of 4.10. However, they were undecided whether their students have access to all forms of technology at any time during the instructional day with a mean of 3.10. And most of them disagree in relying on others (assistant, co- worker, or volunteer) to do computer related tasks with a mean of 2.10.

## DISCUSSIONS

The findings of the study are enumerated. The result showed "no significant difference in the interpretation of the Pre-test result of both the experimental group and control group before the experiment. After the exposure to multimedia, the Post Test result of experimental group was significantly different in the three skills tested (understanding, investigating, and calculating or computing) for the topic

Boyle's Law. The students had a positive attitude towards the subject and showed interest in the integration of multimedia in learning chemistry specifically on the topic Boyle's Law. In the same manner, teachers were also showing positive responses in terms of the integration of ICT or multimedia in teaching. They valued on how important multimedia in making learning more meaningful. They also cited how the 21<sup>st</sup> century learners should learn using Multimedia Technologies. However, they enumerated the barriers and factors which hinders the full implementation of the Multimedia integration such as: it's time consuming to prepare slides or power point presentations, needs expertise of teachers when it comes to manipulating/ operating the multimedia technology, the resistance or adaptive capability of teachers to change, high initial cost, lack of multimedia resources, connectivity to the internet or Wi-Fi is limited, lack of ICT training, during power shortage or block-out, multimedia can't be used, and the inconsistency in the implementation of the DepEd guidelines when it comes to bringing gadgets inside the school premises. To address the needs, the learning exercises are designed and adapted to enhance students' performance in the subject chemistry.

### CONCLUSION

Based on the findings of this study, the researcher found out that multimedia play a vital role in enhancing student's learning-engaging activities. Data shows that there is a need for the students to be grounded more on skills than the acquisition of knowledge and information. The proposed learning exercises for grade 10 science will greatly help the students in concretizing learning. Mayer is true in his statement in 2005, "Learning is enhanced when words and pictures are used together. So, teachers and all DepEd personnel must work hand in hand to integrate hands-on methods or perform more activities which are tactile and technology driven." Multimedia integration is at its best to achieve learning effectively, more meaningful and can master the 21<sup>st</sup> century skills of learners.

### RECOMMENDATIONS

In view of the foregoing conclusions and implications, the following recommendations are hereby presented. Since the students need to learn more about scientific skills in understanding, investigating, and calculating based on the chemistry topic, Boyle's Law (Gas law), the teachers should enrich the teaching guides and modules by adapting the proposed learning exercises appended/ attached in this research book. Since findings have revealed that the students in Chemistry have positive attitude towards the subject and towards the integration/ use of multimedia technology, then it is highly recommended that the administration and the faculty should work hand in hand in maintaining the learning environment conducive for learning by providing multimedia technologies such as Smart TV, allowing gadgets like cellphones, laptops, tabs, etc. inside the classrooms so that learnings will be smoothly delivered with authenticity. The students should be given more opportunities to actually perform laboratory activities, stimulated to acquire different scientific skills in Chemistry through researches, and demonstration classes with the aid of multimedia technologies. Moreover, the school should give attention to the determinant factors which hinder students' achievement in chemistry and make necessary measures to improve and attain better achievement.

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