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Effectiveness of Using Graphics Interchange Format (GIF) in Teaching Chemistry

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ABSTRACT: The study utilized a quasi-experimental method of the pretest-posttest design with pre-selected groupings for the control and experimental groups. The study used validated researcher-constructed questionnaires to determine the student's performance during the experimentation. A pretest was implemented for both groups prior to the implementation of the proposed interventions, with the experimental group exposed to online lectures with GIF-Enhanced Instructional Materials, while the control group utilized conventional online lectures. After the implementation of both interventions, a posttest was administered, and an attitude survey toward Chemistry. The findings showed that both groups had a significant improvement in terms of their performance from the pretest to the posttest, but the significant difference between the mean gains of both groups favored the experimental group. The experimental group was positive about the use of GIF in teaching Chemistry, while the control group somewhat agreed on the positive impact of Chemistry, while the experimental group agreed. In conclusion, using GIFs in online lectures proved to be more effective and impactful than conventional online lectures.

Keywords: GIF, instructional materials, conventional learning, online learning, chemistry

INTRODUCTION

Education has always piqued the interest of most researchers ever since. Researchers are on a mission to find better solutions and remedies to the current educational pedagogies' problems. In the Philippine setting, the science education curriculum is continuously being improved to provide students with more significant opportunities and realize the relevance of the laws and principles being studied to real life [1].

Chemistry has always been the centerpiece for its utmost importance to all other science branches among many other sciences. Merriam-Webster dictionary defines Chemistry as a branch of science that deals with studying the building blocks of matter and life. Many students still perceive the subject as complicated and challenging [2] while others who enrolled in this subject find it too abstract and mathematical for them to understand [3]. With a sudden shift to remote and online learning due to the COVID-19 pandemic, Chemistry became even more challenging for both students and educators with the emergence of new technological challenges and instructional strategies [4].

One of the recent global crises that the world has faced was the emergence of the COVID-19 pandemic. This pandemic brought down any country sector, and one of the most affected is the education sector [5]. The government imposed strict control measures such as lockdowns and community quarantines, thereby forcing educational institutions to temporarily close their gates to combat the virus's spread. These containment efforts affected almost 28 million Filipino students [6], and they had no choice but to adapt to a 'new normal' in education.

The Department of Education (DepEd) adopted blended learning to ensure the continuity of all the students' learning during the pandemic period. Frequently termed as the "hybrid approach," blended learning is a "combination of online and in-class instruction with reduced in-class seat time for students" [7]. This learning model is often a combination of online delivery infused with best classroom practices and a personalized approach to cater to student's diverse needs and learning styles [8]. New implementations brought about by this pandemic also come with unique challenges as well. One of these is keeping the students motivated and interested during online synchronous sessions. According to Croxton's study, students online tend to focus less, especially if the material is not interactive [9]. For

these reasons, the researcher thought of a unique approach to reinforce and motivate the student's online learning experience.

GIF otherwise known as Graphics Interchange Format (pronounced as dʒɪf or gɪf), is just an image format file in its simplest form. According to WhatIs.com, GIF is the second most common image format used on the internet after Joint Photographic Expert Group or JPEG [10]. GIF format is unique in the way that it creates "animated images." By animated images, GIFs are not videos for they do not have a sound. In an article by Heinzman, GIFs, just like memes, are gaining popularity nowadays because of how useful they communicating jokes, emotions, and ideas [11]. With these in mind, the researcher came up with an experimental approach to incorporate GIF images during online lesson discussions in teaching specific chemistry topics in Junior High school. The researcher believes in the study of Pulley, proving that visuals such as GIFs vitalize and enrich the curriculum and serve as aids in teaching, especially in online content [12].

In this premise, the researcher sought to investigate the effectiveness of incorporating GIF in teaching Junior High School Chemistry.

This study aimed to determine the effectiveness of incorporating Graphics Interchange Format or GIFs in teaching Junior High Chemistry.

Specifically, this study sought to answer the following questions:

1. What is the pretest-posttest performance in Chemistry of the students in the:
    1.1. Control group (exposed to Conventional Online Lecture) and
    1.2. The experimental group (exposed to Online Lecture with GIF-Enhanced Instructional Materials)?
2. Is there a significant mean improvement in the Chemistry performance from the pretest to the posttest of the students in the:
    2.1. Control group (exposed to Conventional Online Lecture) and
    2.2. The experimental group (exposed to Online Lecture with GIF-Enhanced Instructional Materials)?
3. Is there a significant difference in the mean improvement in Chemistry performance between the control and the experimental group?
4. What is the level of attitude of the experimental group towards the use of Graphics Interchange Format (GIFs) in teaching Chemistry?
5. What is the level of attitude and perception of the control and experimental group towards Chemistry?

RESEARCH METHODS

Research Design

This study utilized the quasi-experimental method since the research subjects were already pre-selected by the school so they were grouped through heterogeneous sectioning. Specifically, this study utilized a pretest-posttest design. The manipulated variable in this study is the intervention, GIF – Enhanced Instructional Materials in teaching online classes in Junior High School Selected Chemistry topics.

Research Environment

This study was administered at a public high school with a specialized science curriculum located in Argao, Cebu, Philippines. The school operates under a specialized science curriculum under one centralized system, an attached Department of Science and Technology agency. It was first founded in 2005. It aims to nurture scholars into well-rounded individuals who are professionals in the field of science and mathematics.

The school where the research was conducted offers Junior and Senior High school programs. Their Junior High School program is centered around science and technology. The strand offered in their Senior High School program is the Science, Technology, Engineering, and Mathematics.

To continue the students' education despite the pandemic situation, the school adopted the CuRBL or the Curriculum under Remote Blended Learning, a full online modality under distance learning.

Research Subjects

The study was conducted to Grade 8 students, which the school classifies as the “exploratory” phase of the school’s curriculum. These students belong to pre-identified heterogeneous sectioning, by which two of the three Grade 8 sections were selected. There were thirty (30) students from Section A and thirty (30) students from Section B. All of these students were taking up the subject Integrated Science 2. The students from Section A were exposed to the GIF-Enhanced Instructional Materials, while those from Section B were exposed to the conventional way of doing online lectures.

Data Gathering Procedure

This study had the following stages: research permission, pilot testing, analysis of pilot test data, pretest administration, experimentation, posttest administration, attitude inventory towards Science (both the control and experimental groups), and attitude inventory towards the use of GIF-Enhanced Instructional Materials in Online Lectures. A transmittal letter was given to the campus director of the said public high school in Argao, Cebu. After the approval, letters for the students and parents were shown to ask permission to be the research respondents with the assurance that the study strictly adhered to the Data Privacy Act and Child Protection Policy. This study was administered in the Fourth Quarter of the school year from April to May of 2021. The control and experimental groups were already identified since the researcher was the one who implemented the study. The researcher then administered a validated pretest to the students. There were sets of questionnaires for the five (5) selected topics in Chemistry. The five topics that were covered were the following: (1) Development of the Periodic table, the Periodic Properties of Elements such as (2) Atomic Radius, (3) Ionization Energy, (4) Electron Affinity, and (5) Electronegativity.

Experimentation then was implemented, wherein the control group was exposed to the Conventional Online Lecture, while the experimental group experienced the Online Lecture with GIF-Enhanced Instructional Material. After which, a posttest was administered.

After the pretest-posttest of the selected topics, an attitude inventory toward Chemistry was administered to both control and experimental groups. On the other hand, another attitude inventory toward using GIF-Enhanced Instructional Materials was administered to the experimental group. The attitude inventories were done through Google Forms. A focused group discussion was administered to enrich and validate the results. The data gathered was used to answer the problems of the study.

Pedagogical Approach

Two pedagogies were utilized in this study to teach the basic concepts of selected topics in Chemistry, specifically on the Development of the Periodic Table and the Periodic Properties of Elements in the Integrated Science 2 classes of Grade 8 students. One group (the experimental group) was taught using the GIF-Enhanced Instructional Material, while the other group (the control group) used the conventional online lecture. The researcher also served as the teacher who utilized both approaches.

Research Instrument

The researcher utilized a validated teacher-constructed questionnaire for the pretest and posttest. The questionnaire was validated by three highly qualified Chemistry teachers or professors in their respective schools. After the validation from experts, the questionnaire was pilot-tested. The data from the pilot test were analyzed using the split-half reliability. The reliability value of the instrument was found to be at 88.50%, making it highly reliable to be used in the pretest and posttest. The questionnaires were composed of multiple-choice questions for objectivity and worth 30 points; 6 points for each of the five topics selected for this study.

A revised version of an adapted Chemistry Attitude and Experiences Questionnaire by Coll et al. [13] was administered to both groups to determine the students' attitudes toward Chemistry. Using the same standardized questionnaire that was adapted and revised was used to assess the attitude of the experimental group toward the use of GIF-Enhanced Instructional Material. Focused group discussion (FGD) was done to support the data gathered.

Statistical Treatment of Data

1. **One sample t-test** was used to determine the pretest and post-test performance of the control and experimental group.
2. **A paired sample t-test** was used to determine the mean gain from the pretest to the posttest performance of both the control and experimental groups.
3. **A T-test of the independent sample** was used to determine the difference in the mean gains between the control and experimental groups.
4. **The weighted mean** was utilized to determine the attitude of the Grade 8 students toward Chemistry and the use of GIFs in online lectures

All tests were set at a 5% level of significance.

RESULT AND DISCUSSION

Students' Level of Performance in Chemistry

Table 1 shows the pretest performance level of the Grade 8 students in Chemistry. As shown from Table 1, both groups obtained an actual mean that is much lower than the hypothetical mean, which is

the passing standard of the school. The actual mean of 14.4 (SD = 5.92) of the control group and 14.3 (SD = 4.49) of the experimental group are significantly less than the hypothetical mean. The computed t-value of 3.33 for the control group, with its p-value of 0.002 less than α=0.05, is less than the significance level. On the other hand, the experimental group obtained a t-value of 4.47, with a p-value of 0.000, which is less than α value of 0.05, is less than the significance level. This means that the students in both groups had significantly lower performance than the school's passing standard, which is 60% of the perfect score.

TABLE 1. Pretest Performance of the Control and Experimental Groups

Group	n	Hypothetical Mean[a]	Actual Mean	SD	Test Statistics		Qualitative Description
					Computed t-value	p-value	
Control (Conventional)	30	18.0	14.4	5.92	3.33*	0.002*	Below Average
Experimental (Exposed to GIF)	30	18.0	14.3	4.49	4.47*	0.000*	Below Average

a = refers to the 60% passing standard of the school
** = significant*

The students' performances in the pretest may imply that students might have little to no knowledge of the Periodic Table and the Periodic Trends. The result was expected since the topics were not discussed yet.

TABLE 2. Posttest Performance of the Control and Experimental Groups

Group	n	Hypothetical Meana	Actual Mean	SD	Test Statistics		Qualitative Description
					Computed t-value	p-value	
Control (Conventional)	30	18.0	19.4	5.93	1.29^{ns}	0.206^{ns}	Average
Experimental (Exposed to GIF)	30	18.0	23.5	4.47	6.70*	0.000*	Above Average

a = refers to the 60% passing standard of the school
** = significant*
ns = not significant

Table 2 indicates the post-test performance of the Grade 8 students in Chemistry. In this table, the control group obtained an actual mean of 19.4 (SD=5.93) while the experimental group had an actual mean of 23.5 (SD=4.47). The computed t-value for the control group and the experimental group were 1.29 and 6.70, respectively. The p-value for the control group is 0.206, while the experimental group is 0.000. The significance level or the alpha value is set at 0.05, and the degree of freedom is 29.

The p-value of the control group is greater than the significance level and is considered not significant. This indicates that the actual mean of the control group did not differ significantly from the hypothetical mean. This shows that the control group's performance in the post-test was Average. The control group just barely reached the 60% passing criterion set by the school. On the other hand, the p-value of the experimental group is less than the significance level and is considered significant. This result indicates that the actual mean of the experimental group was significantly higher than the hypothetical mean which means that their performance in the posttest was Above Average. This Above Average performance means that the experimental group exceeded the 60% passing standard of the school.

This Average performance of the posttest of the control group might be attributed to the conventional lecture given to this set of students. The conventional online lecture was carried out in the study using plain online visual aid such as PowerPoint through virtual classrooms like video conferencing applications. The posttest result under conventional online lectures supported the study of Bahasoan et al. [14] which stated that plain online lectures could still be effective but inefficient.

The Above Average post-test performance of the experimental group might be because of the GIF-enhanced online lectures. In this study, the online lecture materials such as PPTs were enhanced by GIF images to maintain students' focus and improve performance. GIF images in online lectures proved to put students at ease and helped them process ideas easily [15].

Not only are GIFs fun to watch, but at the same time, it aids the students to remember a particular idea introduced during an online lecture.

Students' Mean Improvement from the Pretest to Posttest in Chemistry

TABLE 3. Mean Improvement from Pretest to the Posttest of the Control and Experimental Group

Group	n	Pretest	Posttest	$\bar{d}$	S_d	Test Statistics	
						Computed t-value	p-value
Control (Conventional)	30	14.4	19.4	5.0	6.5	4.21	0.000*
Experimental (Exposed to GIF)	30	14.3	23.5	9.2	4.8	10.3	0.000*

** Significant*

Table 3 shows the mean gain of 5.0 from the pretest to the posttest of the control group and a mean gain of 9.1 from the pretest to the posttest of the experimental group. The computed t-value for the control group is 4.21, while for the experimental group is 10.3. The p-value for both groups is 0.000, which is less than α = 0.05. Since the p-values of both groups are less than the significance level, thus significant. Therefore, both groups exhibited significant improvement in their performance in Chemistry. This improvement might be attributed to both groups being substantially exposed to their respective interventions.

The control group's significant mean gain in terms of their performance from the pretest to the posttest could be attributed to how they focused and listened during the online lectures. The conventional online lectures using only plain PowerPoint presentations proved to be instrumental in improving the control group's performance. It could also be attributed to students being highly motivated to understand chemistry concepts despite the online setup. In fact, according to the study of Paul & Jefferson [16], neither traditional nor online modalities can affect a student's performance.

In the experimental group, the significant mean gain could be attributed to the addition of animated images such as GIFs which were included in the PowerPoint presentations. In a meta-analysis study done by Baker et al. [17], PowerPoint presentations did not affect learning unless instructors considered using animated pictures such as GIFs to catch and hold students' interest.

Comparison Between the Control and the Experimental Groups in Terms of their Mean Gains

The difference in mean gains between the control group and the experimental groups is shown in Table 4.

TABLE 4. Differences in Mean Gains Between Control and Experimental Groups

Group	n	Mean Gain	S_d	Difference Between Mean Gains	Computed Statistics	
					Computed t-value	p-value
Control (Conventional)	30	5.0	6.5	4.2*	3.0	0.004*
Experimental (Exposed to GIF)	30	9.2	4.8			

** = significant*

Results from Table 4 show a difference of 4.2 between the means of control and experimental groups, which favored the experimental group. The computed t-value is -3.0 while the p-value is at 0.004, which is less than α=0.05, thus significant. This finding means that there was a significant difference between the experimental and control groups' mean gains. Students learned better when GIFs were infused into PowerPoint presentations during online lectures. Animated pictures in the form of GIFs were used as visual tools for discussing abstract concepts. This proved to be helpful as what has been claimed by Franco-Mariscal et al. [18] in their study using interactive tools in teaching the Periodic Table, which was supported by the present findings. Therefore, students in an online setup learn better when they see easily understood concepts, such as animated pictures in the form of GIFs. Since GIF images show the same thing repeatedly, it helps the students remember certain concepts due to repetition. This enabled them to perform better when taking the exams in Chemistry that are deemed abstract and challenging. Lastly, GIFs infused in visual aids such as PPT presentations are simple because they can be found on the internet and are reliable in simply copy-pasting them in one's instructional materials.

Student's Attitude Toward the Use of GIFs in Chemistry

As shown in Table 5, students manifested a Very Positive attitude towards the use of GIFs. This result was based on the standardized descriptor on a five-point Likert scale by which the experimental group got a mean of 4.35 and a standard deviation of 0.73. This result was supported by the positive feedback of the students during the Focused Group Discussion done by the researcher. Hence, in this study, the use of GIF helped them gain their focus on the online lectures and be engaged with chemistry topics resulting in a gain in knowledge. Yet, based on the feedback, it is worth noting that overdoing GIF might also lead to distraction rather than engaging students in the lessons. But based on this study, the benefits still outweighed the risks.

TABLE 5. Attitude of the Students in the Experimental Group Toward the Use of GIF in Chemistry

Group	n	Mean	SD	Qualitative Description
Experimental (Exposed to GIF)	30	4.35	0.73	Very Positive [a]

[a] ***Based on a five-point Likert scale: 1.00-1.80 = Very Negative; 1.81-2.60 = Negative; 2.61-3.40 = Neutral; 3.41-4.20 = Positive; 4.21-5.00 = Very Positive***

Student's Attitude Toward Chemistry

The students were also assessed on their attitude in terms of their attitude and perceived confidence toward Chemistry as a subject. The results are presented in Table 6 for the students' attitude and in Table 7 for the students' perceived confidence toward Chemistry.

TABLE 6. Attitude of Students Toward Chemistry

Group	n	Mean	SD	Qualitative Description
Control (Conventional)	30	5.34	1.45	Somewhat Positive [a]
Experimental (Exposed to GIF)	30	5.57	1.28	Positive [a]
Overall	60	5.46	1.37	Positive [a]

[a] *Based on a seven-point Likert scale: 1.00-1.86 = Very Negative; 1.87-2.73 = Negative; 2.74-3.60 = Somewhat Negative; 3.61-4.47 = Moderate; 4.48-5.34 = Somewhat Positive; 5.35-6.21 = Positive ; 6.22-7.00 = Very Positive*

Table 6 shows the Grade 8 students' attitude toward Chemistry wherein they answered a series of dichotomy questions with one being positive and the other being negative. The control group obtained a 5.34 (SD=1.45) mean, while the experimental group had a 5.57 (SD=1.28). Using a standardized descriptor from a seven-point Likert scale, the control group had a Somewhat Positive attitude toward Chemistry. In contrast, the experimental group had a Positive attitude toward the Chemistry subject. Overall, the students obtained a mean of 5.46 (SD=1.37), which means that their overall attitude toward Chemistry is Positive. The Somewhat Positive result of the control group could be attributed to how the Chemistry topics were delivered during the online lectures in plain PowerPoint presentations. The Positive result of the experimental group could be because of how they were engaged with the GIFs that were infused in the visual materials during their online lectures.

All in all, the students Positively perceived Chemistry, which means that the students generally exhibited a positive attitude toward Chemistry. This observation and result agreed with the study of Cheung [19], wherein the results stated that the only way for students to have a strong positive attitude toward Chemistry was if the lessons were enjoyable and engaging. Therefore, students would perceive an agreeable perception toward an abstract subject such as Chemistry if the teachers would also find ways to make it likable and enjoyable.

Table 7 shows the students' perceived confidence when given dichotomy questions about how confident they are in different chemistry tasks. The control group had obtained a mean of 2.98 (SD=1.10), while the experimental group had 3.22 (1.07). Overall, the students got a mean of 3.12 with a standard deviation of 1.09. Using the standardized descriptors from a five-point Likert scale, the control group fell on the Neutral description, while the experimental group got Neutral, and overall, the result is Neutral. This result may imply that the students were neither confident nor hesitant in undertaking different chemistry tasks.

TABLE 7. Perceived Confidence of the Students Toward Chemistry

Group	n	Mean	SD	Qualitative Description
Control (Conventional)	30	2.98	1.10	Neutral [a]
Experimental (Exposed to GIF)	30	3.22	1.07	Neutral [a]
Overall	60	3.12	1.09	Neutral [a]

[a] *Based on a five-point Likert scale: 1.00-1.80 = Very Negative; 1.81-2.60 = Negative; 2.61-3.40 = Neutral; 3.41-4.20 = Positive; 4.21-5.00 = Very Positive*

Summary of Findings

1. The control and experimental groups' performance in the pretest falls under the Below Average category. However, in the posttest, the control group exposed to conventional online lectures showed an Average performance. In contrast, the experimental group that was exposed to GIF-enhanced online lectures got an Above Average performance.
2. There were significant mean gains in the performance of the control group and experimental group in terms of their performance from the pretest to the posttest.
3. There was a significant difference between the mean gains of the control and experimental groups that favored the experimental groups.
4. The students in the experimental group had a very positive attitude toward the use of GIFs in teaching Chemistry.
5. The control group was somewhat positive in terms of their attitude toward Chemistry, while the experimental group revealed a positive level of attitude. The students agreed to perceive Chemistry positively. In terms of perceived confidence toward Chemistry, both groups were neutral, so that they were neither confident nor negative about undertaking different tasks in Chemistry.

CONCLUSION

Online lectures can be very tough for both the students and the teachers. Chemistry, a subject considered abstract, makes it even more challenging for students to learn and be engaged. Using these accessible visual tools such as GIFs can be appealing and educational for the students. Hence, the Graphics Interchange Format (GIF) is tested to see its effectiveness in teaching Chemistry under the virtual setup.

Based on the study's findings, the use of Graphics Interchange Format or GIFs in online lectures was proven to be a more effective means than the conventional online lectures as evidenced by better performance and manifestation of a very positive attitude of the experimental group of students. This finding affirmed Richard Mayer's Multimedia Principle, which states that presenting animation with narration promotes learners' understanding, especially in online lectures. In addition, the students' sentiments in the experimental group, though very positively view GIFs as useful and engaging, still have reservations about not overloading the presentations in online lectures with GIFs. This finding also affirmed the Cognitive Load Theory by John Sweller, which states that students should not be bombarded with many instructional elements such as animated pictures so as not to overload them cognitively. Thus, if teachers could only maximize the use of GIFs in their online classes, it can be expected that online classes could be as fun as the traditional mode of teaching.

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