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Research Article

Enhancing the Teaching of Water Cycle Through an Interactive Multimedia: A Quasi-Experimental Research

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Abstract

Pedagogical approaches are constantly being evaluated based on their effectiveness. The works of the literature pay little to no attention in assessing strategies for teaching the water cycle. The water cycle topic in grade 4 was not sufficiently investigated in terms of finding a more effective method of instruction. This study intends to assess the efficacy of interactive multimedia as a strategy for teaching the water cycle to grade 4 learners of Cansayahon Elementary School- Cansayahon, Ronda, Cebu, Philippines. There were two groups, experimental and controlled, each containing 15 respondents. This study utilized a quasi- experimental research design. The pretest results revealed a mean of (10 and 12.93) for both groups, respectively. The post-test showed a 4.86-point difference between the experimental group's mean (16.13) and the controlled group's mean (11.27) by utilizing the significance level of 0.05, the results between the two groups were found to be statistically significant (p=0.00 and 0.00). The average value of the experimental gain class is higher (41), compared to the average value of the class of gain control (32). According to the results of this study, there are significant distinctions between learning with interactive multimedia and learning without multimedia in general. It is recommended that teachers can utilize the successful results of this research as a tool to support students' academic progress, particularly in earth and life science. Also, further study can be done in validating the results of this study.

Keywords: Interactive Multimedia, Traditional Method, Water Cycle, Quasi-experimental

Introduction

Education at any level aims to ensure that all students receive the knowledge and skills required to apply it. A straightforward instructional goal, explanation, elaboration plans to lead to task performance, sequencing, drill repetition, offering strategy clues, and domain-specific processing can all be components of an effective teaching technique (Guirguis & Pankowski, 2017). It is the responsibility of every educator not only to be familiar with their pedagogical approaches but also to be aware of how to use them in the classroom effectively. This will ensure that education serves not just the interests of students but also those of their instructors. Every educator should have their ways of presenting topics to students wherein students can quickly comprehend the topics using the strategies (Munawaroh, 2017). Because of this, the level of engagement shown by students in their education is directly proportional to the number of different pedagogical approaches utilized (Sapuroh et al., 2018). In the literature, little to no attention was given to the assessment of different strategies on specific topics that can incur better academic performance among the learners. This study assessed interactive multimedia as a strategy in enhancing the teaching of the water cycle.

According to the study by Wang (2017), the use of multimedia in the classroom makes the job of teachers significantly easier; nevertheless, in practice, many educators continue to choose more traditional modes of instruction simply because it is more convenient for them to do so. The teaching-learning process can benefit from a wide range of educational tools and technologies. There are numerous advantages for both teachers and students when using multimedia into classroom instruction. Multimedia teaching should be encouraged and supported by teachers. In order to maximize the integration of scientific and logical multimedia use and enhance teaching quality improvement, teachers need to be well-versed in all the benefits of multimedia.

The fourth-grade science curriculum encompasses a vast array of topics. The water cycle is one of the essential science topics at this level and is not yet thoroughly investigated in terms of the different strategies that can be utilized (Abbott et al., 2019). Academic planning is one of the techniques professors use in scientific lectures; it allows learners to create representations, create their concepts clearly, and provide model-based explanations for complex

phenomena, including the water cycle (Baumfalk et al., 2018). In addition, multimedia technology provides an alternative to direct observation as a method of instruction in elementary schools, particularly for science education on the water cycle (Nur'Azizah et al., 2018).

Learning in a usual manner frequently leaves students unmotivated and bored (Mufida et al., 2020). Technology plays a crucial role in education, learning, and faculty development during this time of the pandemic. As demonstrated by Padmasari et al. (2021), the demand for digital media education is growing, particularly as the present generation of elementary school pupils readily adapt to technology. Consequently, using multimedia increases the likelihood of remembering scientific information. Therefore, this study exemplifies further in determining the importance of multimedia technology's impact on conventional science teaching techniques (Kapri, 2017).

This study defined media presentation as a tactic used in the classroom to improve lesson delivery. Multimedia is an effective means of transmitting and receiving easily understood communications. The use of media elements strengthens the message and delivery, resulting in a higher rate of learning. Multimedia's power lies in its multisensory nature, stimulating the audience's various senses. It is also interactive, allowing users to control multimedia content and information flow (Kapri, 2017). Innovative learning technologies are a systematic way to create, apply and define technical and human resources and their interrelationships, with the goal of enhancing the effectiveness of forms of learning throughout the learning and learning process (Abdimannobovna et al., 2019).

According to Septiani et al. (2020), the fast-shifting paradigm of education is being impacted by the rapid growth of digital technology. Education, on the other hand, has a significant role to play in the development of children with strong moral character. It is the goal of this study to be defined and tested by experts and practitioners, and student responses should be tested as a result of using such courseware. Experts, professors, and students were all involved in this research and development. Surveys of students, teachers, and experts were all used to get the data. Mean and percentage were used to determine their statistical significance. Using three key components from the research, IMONEC (Interactive Multimedia courseware integrated with Bandura's observational learning model and national historical events to strengthen students' character) was created, a program that combines the principles of interactive multimedia learning with Bandura's observational learning model as well as the high moral values and messages of historical national events to improve students' moral character. IMONEC Title, user instruction, home, core competency, and basic competency are all components of the interactive multimedia courseware's framework. The findings of the expert validation, teacher questionnaire, and student questionnaire demonstrated that the interactive multimedia courseware may be used in learning and is beneficial in building students' character.

This study examined the efficacy of using interactive multimedia to teach the water cycle to fourth graders. Furthermore, this study highlighted the necessity of integrating multimedia tools into the classroom, which has been shown to improve students' academic outcomes in the literature.

Research Questions

This study determined the effectiveness of computer simulation as a strategy in teaching the water cycle among Grade 4 learners. Further, this study elicited pertinent information in responding to the question:

1. What is the pre-test result of the two groups of respondents?
    1.1. Experiment Group
    1.2. Controlled Group
2. What is the post-test result for the two groups of respondents?
    2.1 Experiment Group
    2.2 Controlled Group
3. Is there a significant difference between the pre-test and post-test scores of the controlled and experimental groups?

Literature Review

This section highlighted the different essential references and works of literature that support the significance and relevance of the study's conceptual framework. The researchers meticulously choose highly refereed, scholarly-created articles, publications, and journals based on the inclusion criteria's fundamental tenets.

Nur'Azizah et al. (2018) emphasized the significance of using interactive multimedia as instructional material for the water cycle to improve students' analytical thinking. They proposed three instructional

materials for the water cycle (multimedia-based, print, and presentation). It was discovered that students are highly interested in all computer-related topics and computer-based media. This is evident by the fact that the percentage of acquisition based on the students' selection of multimedia is 95.24 percent, which is higher than the selection of print media (47.17 percent) and presentation options (50 percent). It was also emphasized that interactive multimedia significantly impacts academic performance and enhances students' analytical thinking skills.

Nurlaili and Sari (2020) showed that the students still don't understand the water cycle well and have a lot of wrong ideas, which can be seen in their drawings of the water cycle. Drawing tests show that the students still don't fully understand the water cycle concept. Though some students can answer multiple-choice questions using CAI, it does not appear that they completely understand the concepts. The misunderstanding happened not only because of how the students' work turned out but also because of what the CAI said. Teachers should be educated on the properties of CAI, computers, and computer usage to utilize CAI effectively. CAI can't be successful if teachers don't know much about computers and CAI. Misconceptions can be avoided and kept to a minimum by enhancing the content and presentation of CAI to effectively communicate the information. Sustainable development will happen if education needs are met by making CAI better.

In the study of Mufidah et al. (2020), the impact of explaining the water cycle via a technology-based medium such as audiovisual learning videos was enhanced. Based on contextual teaching and learning in water cycle science, this study intends to develop audiovisual stop-motion video educational materials for fifth-grade elementary schools. The study revealed that the water cycle material would not be effectively communicated without being delivered through lectures. It reveals that image-based learning materials are the simplest way to convey water cycle information to students, allowing them to visualize the water cycle process. In addition, the results revealed that using stop-motion learning is advantageous and has a favorable impact. Using stop-motion audiovisual video media can enhance online teaching and learning efficacy and efficiency, particularly for water cycle-related topics.

Syawaludin et al. (2019) claimed that elementary school teacher education programs should be able to equip new teachers to do complicated teaching tasks, such as teaching science, at the elementary level. Science instruction in primary schools should be engaging and applicable so that students can learn about themselves and their natural environment and future opportunities for applying these concepts in their daily lives. Without interactive multimedia, the science learning process in Preservice primary schools was less dynamic, according to their research. For elementary school teacher education, the creation of interactive multimedia-based AR was urgently needed for scientific education. This study finds that using interactive multimedia based on augmented reality could improve the ability of fourth-grade primary students to think abstractly.

The study of Ayimbila & Pappoe (2022), states that multimedia in Science education affects student performance. His research demonstrates that using multimedia to teach a particular subject proved superior to conventional techniques. In this study, the control group led some ideas using traditional methods, but the experimental group was taught via multimedia. The post-test results revealed that the experimental group's achievement and acquired retention were superior to the control groups. This indicates that activity-oriented multimedia in teaching Science can improve students' competency, cooperation, and patience and that multimedia represents a turning point in improving education.

During this time of the pandemic, doing research on a specific strategy is vital (Perez, et al., 2022). Teachers should find a remedy for how to deliver quality instruction in modular instruction (Cabello, 2022; Riconalla et al., 2022). At times, students procrastinate (Olleras et al., 2022) because of losing interest in the subject matter, especially Science. A differentiated instruction strategy can ignite the interest of the students to share their knowledge regarding the topic. However, during this time, parents are the ones accomplishing the tasks (Abucejo et al., 2022) of the students, especially the science activities in the module. If the students are having challenges in understanding science concepts, they can take advantage of the online resources if they have strong internet connectivity (Bahinting et al., 2022). Learners should continue learning even if the unprecedented event – Coronavirus - hinders the quality of education being forwarded to them (Ando et al., 2022). This study can be a manifestation that there’s always a way to deliver a topic in the most engaging way possible.

According to Fayanto et al. (2019), the benefits of using multimedia are more engaging and participatory. Teaching time can be reduced, the quality of student learning can be enhanced, the teaching and learning

process can occur anywhere and at any time, and student attitudes can be enhanced. Multimedia learning can boost student engagement and comprehension. The research supports the notion that students will be encouraged to pursue information and receive immediate feedback as a result of using multimedia as a learning medium. Consequently, the development of multimedia in the classroom is predicated on the premise that the communication process in learning will be more relevant if supported by several media. It can pique students' interest and facilitate comprehension of the issue.

According to Alemdag et al. (2018), words and images are combined in various circumstances to form an image in the mind. Help students learn by providing tools that may be utilized in classroom or laboratory settings to deliver knowledge in both verbal and graphical formats. This allows learners the ability to comprehend information in both verbal and pictorial forms. The use of multimedia for educational purposes necessitates familiarity with ideas like the cognitive theory of multimedia learning, which makes three basic assumptions about how students learn from multimedia lessons. Assumptions like dual-channel, restricted capacity, and active processing can be summarized in this way (Alemdag et al., 2018). It is assumed that students have multiple ways to segregate visual and audio information while using the dual-channel approach. Restrictive capacity assumes that the amount of data that can be processed in each channel is limited. Teachers will be able to avoid overburdening their students with knowledge if they are aware of these. Students, on the other hand, will be aware of their own processing powers and limitations. When it comes to the selection, arrangement, and integration of information in the world, humans are active agents and can manage the information they are interacting with, according to active processing.

There are numerous studies on how interactive multimedia may be used in today's classrooms to provide a meaningful learning experience as well as the positive effects it can have on the teaching-learning process. In addition, when talking about the water cycle, the best strategies and a wide range of learning activities should be included to fulfill the needs of each individual. This method will transform a direct teaching-learning process into an engaging, interesting, and collaborative one. Students' attention and participation in the water cycle topic are stimulated as a result of this. As a result, relevant learning experiences can be established, and positive changes can be implemented, leading to a better education for students.

Methodology

This section entails the nature of the methodology. This is quantitative research utilizing a quasi-experimental research design. This method is essential in pursuing an action research. The goal is to test how effective a strategy is by selecting and choosing the respondents to be tested into two groups (the control group and experimental group) arranged and controlled accordingly. There will be a pre-test and a post-test for both groups. The control group will be conventionally given the water cycle, while the experimental group will apply the to-be-tested technique, Interactive Multimedia.

Participants

There will be 30 students from Grade 4 students. They will be divided into the controlled group (15 respondents) and the Experimental Group (15 respondents). The sampling will run for a week of discussing the topic – Water Cycle.

Instruments of the Study

The study used the Weighted Mean and Two-tailed T-test using the Statistics Package for Social Sciences (SPSS).

Weighted Mean

The weighted mean was used to describe the pretest and posttest results.

Two-tailed T-test

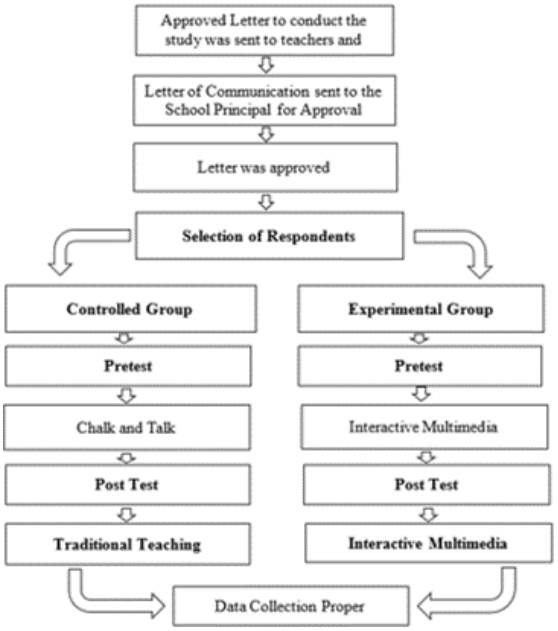
The two-tailed t-test is widely used in establishing critical points of a distribution area whether a sample is greater than or less than a certain range of values. This is also used to prove the null hypothesis's acceptance and rejection. This can also be used in the different statistical analyses comparing two sets of values.

Procedures

A letter of communication was crafted and sent to the Office of the School Principal for approval. After the approval of the letter, the researcher informed the respondents that they will be part of the study. The invitation was set to be voluntary without coercion or any exchange of possible grade accommodation. The ethics of the study were religiously followed. After receiving the confirmation of agreement from the respondents, the researcher divided the respondents accordingly. There were 15 students or respondents per group. After which, the pre-test was administered.

The pre-test was designed and construed by the researcher and went through face validity and content validity (Cabello & Bonotan, 2021). The researcher followed Colton & Covert (2007) in designing and validating the Instrument. The controlled group had the traditional way of learning the topic which is the Water Cycle while the experimental group had the computer simulation as a strategy for learning the lesson. After which, the administration of the post-test commenced. The post-test was also crafted and designed by the researcher who went through the process as the pre-test as their content was just the same. The data gathered was subjected to appropriate statistical tests set in this study.

A flow chart was created to have a clear picture of how the gathering of data is conducted.



Ethical Considerations

The researcher observed ethical principles throughout the conduct of the study. The researcher maintained the highest level of objectivity in the discussions and analysis of findings throughout the study. Works of other authors utilized in this study in any part of the published articles and highly refereed journals with the use of the APA referencing system were acknowledged. Prior to the study, the researcher provided an Informed Consent stating the purpose and objectives of the study to ensure that full consent from the respondents was obtained. According to Bryman and Bell (2007), respondents may withdraw from the study at any time. The researcher noted that the protection of respondents' privacy, identity, and dignity is of the utmost significance. The researcher also ensured that the gathered data from the respondents were given with the highest degree of confidentiality. The respondents were neither harmed nor abused, both physically and psychologically, during the conduct of the research.

Results and Discussion

This part answered the research questions set in this study with discussions and substantiation from the different peer-reviewed articles.

Research Question #1.

1. What is the pretest result of the two groups of respondents?
   1.1. Experiment Group
   1.2. Controlled Group

Table 1. *Pretest Results of the Two Groups*

Respondents	*Pretest (Controlled Group)*	*Pretest (Experimental Group)*
1	7	16
2	9	12
3	9	13
4	8	14
5	9	14
6	8	12
7	12	14
8	10	11
9	11	13
10	8	10
11	11	12
12	13	15
13	11	13
14	13	13
15	11	12
Mean	10	12.93
SD	1.89	1.53

The pre-test scores of both the control and experimental groups are presented in Table 1. In a control group, the highest score obtained was 13, and the lowest was 7, with an overall average of 10 and a standard deviation of 1.89. The highest score for the experimental group was 16, and the lowest was 11, with a mean and standard deviation of 12.93 and 1.50,

respectively.

The pretest findings demonstrated that the experimental group's performance and acquired retention were superior to the control groups. This indicates that activity-oriented multimedia in teaching Science can improve students' competency, cooperation, and patience and that multimedia represents a turning point in improving education.

According to the study by Stanojevic (2018), it is the goal of instructional software to encourage students to learn and to stimulate more speculative behavior, which includes problem-solving and the deliberate application of previously acquired knowledge to new contexts. There are a variety of ways to get kids excited about a new teaching unit, such as using crosswords and song lyrics to advertise it. As a way to foster and nurture students' competitive natures, we can employ associations in the form of a competition. Multimedia learning can boost student engagement and comprehension. Therefore, the development of interactive multimedia is an alternative method for learning in elementary schools where direct observation is ineffective, particularly for science teaching on the water cycle (Nur'Azizah et al., 2018).

The mean score in learning water cycle showed that the controlled group had limited knowledge while the experimental group had in-depth knowledge in learning water cycle. This might be a database used to determine what sort of treatment we should use to fill in the gap. To properly elaborate on the issue, it is important to utilize a variety of educational approaches. Thus, it can be concluded that the interactive multimedia-based instructional media is very valid, practical, and effective to be used in learning water cycle for elementary school. Interactive multimedia learning materials on the water cycle have been declared feasible, and learning outcomes have improved.

Research Question #2.

2. What is the posttest result of the two groups of respondents?

2.1. Experiment Group

2.2. Controlled Group

Table 2. *Posttest Result of the Two Groups*

Respondents	*Posttest (Controlled Group)*	*Posttest (Experimental Group)*
1	8	18
2	7	18
3	7	16
4	9	18
5	8	17
6	11	17
7	11	15
8	11	17
9	12	16
10	11	16
11	14	15
12	14	17
13	13	13
14	15	14
15	18	15
Mean	11.27	16.13
SD	3.17	1.51

Table 2 provided data about the score of the post-test for the control and experimental group with the traditional way of teaching the topic and the utilization of interactive multimedia. The results reveal that the control group has a mean of 11.27 and a standard deviation of 3.17, with the most significant score being 18 and the lowest being 7. In contrast, the experimental group's data revealed that their most excellent score was 18, and their lowest score was 13, with a mean of 16.13 and a standard deviation of 1.51. It demonstrates a statistically significant difference in the scores of the two groups.

After the discussion, the experimental groups demonstrated increased knowledge and comprehension of the topic. It implies that the new strategy being utilized in delivering the instruction improved student's acquisition of learning. Using E-learning tools and Social Media in teaching tactics is one method that may be used to increase learning abilities quickly (Alsheehri et al., 2020). This innovative approach was selected because it will help students gain a comprehensive knowledge of the water cycle at their own pace and from any location at any time.

In the light of finding that were obtained from this study, it can be perceived that the application of the new strategy in discussing a specific topic, sets the higher possibility of achieving in-depth results for the learner's performance. Hence, teachers, as researchers, should be flexible in applying new methods in which

information can be communicated to learners. This can further assist teachers in forwarding meaningful learning experiences.

Research Question #3.

3. Is there a significant difference between the controlled and experimental groups' pre-and post-test scores?

		t-value	*p-value*	*Alpha*	*Decision*	*Interpretation*
Pretest	Control Experimental	-4.66774	0.000069	0.05	Reject Ho	Significant
Posttest	Control Experimental	-5.36707	0.00001	0.05	Reject Ho	Significant

*Significance level is $p < 0.05$

As shown in Table 3, the test showed a significant difference between the pre-and post-test scores of the control and experimental group. It can be gleaned that in the pretest, the result has a p-value of 0.000069 which the hypothesis needs to be rejected with an alpha of 0.05. Thus, the pretest reveals a considerable difference. The posttest of the two groups garnered a p-value of 0.00001 resulting in rejecting the null hypothesis given the alpha being set in the analysis the p-value is interpreted as having a significant difference. The utilization of multimedia in discussing the water cycle is more effective than traditional teaching methods. The table shows that both groups' pretest scores and posttest scores indicate a meaningful difference. With this, it is implied that the pupils gained more knowledge and understood the topic better by integrating multimedia in teaching the water cycle.

This also implies that the teaching strategy would affect the pupils' performance. In the research conducted by Farouga and Hysaj (2022), new technologies will increase student involvement. Engaging students' learning enhances their concentration and focus, motivates them to employ more advanced critical thinking strategies, and generates authentic learning experiences. It was supported in the study of Lei et al. (2018) that student engagement and academic achievement have a positive correlation with each other. Multimedia teaching methods stimulate the children's interest in effectively learning the concept, and it will make the teaching-learning process more interesting.

In the study of Nur'Azizah et al. (2018), the ability of pupils to think critically about the water cycle can be significantly improved by the use of interactive multimedia, as this effect has been proven. with this, the result of having significance can be interpreted as that interactive multimedia enhances the effectiveness of teaching the water cycle.

Conclusion

Information and communication technology has made a name for itself as an instructional technology tool in today's educational institutions. Multimedia has overcome time and space constraints and is now recognized as a medium for educating multidisciplinary masses at any time and in any location. Knowledge acquisition becomes more efficient when learners experience an event through a multimedia simulation. By enhancing teacher-student interaction, multimedia technology helps the learning process. In addition to providing educators and students with endless chances for high-quality teaching and learning, multimedia can reach the status of a New Educational Technology tool by considering its pedagogical strengths and weaknesses.

This study investigated the effectiveness of video and audio stop-motion media learning based on the relevant teaching and learning. This study found that using interactive multimedia based on augmented reality can improve the abstract thinking skills of fourth-grade children. Students were given pre-and post-knowledge assessments before and after interacting with the application in the experimental group or receiving the traditional teacher-based method in the control group. The experimental group displayed a statistically significant increase in knowledge relative to the control group. This study found that using interactive multimedia based on augmented reality can improve the abstract thinking skills of fourth-grade children.

Based on empirical findings regarding the creation of interactive multimedia learning tools for fourth-grade elementary school students. The following suggestions about media growth can be made: (1) The developed media can be utilized as an alternative or a point of reference when creating media for other materials. (2) Large-scale media testing is still necessary for elementary schools to demonstrate the efficacy of interactive multimedia learning in the classroom. (3) The lack of interactive multimedia learning materials on the water cycle can stimulate the creation of similar media with higher quality, such as dubbing with accurate voice quality to facilitate comprehension of the material's content. (4) Technology is made accessible equitably to boost student learning and

teacher professional development. One strategy for rapidly improving students' learning ability is incorporating e-learning and social media into classroom strategies.

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